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THE QUARTERLY REVIEW of BIOLOGY

PHOTOORIENTATION AND THE "TROPISM THEORY"

BY HAROLD F. BLUM

The National Cancer Institute, National Institutes of Health, Public Health Service, Department of Health, Education and Welfare, Bethesda
and
The Department of Biology, Princeton University
[*Present address: Department of Biology, Princeton University*]

"Keine Ferne macht dich schwierig,
Kommst geflogen und gebannt,
Und zuletzt, des Lichts begierig,
Bist du Schmetterling verbrannt."
—Goethe.

Based on a lecture delivered in the Department of Zoology, under the auspices of the Graduate School, University of Toronto, December, 1949

THE term *photoorientation* is used here to include all types of movement which tend to bring living organisms into geometrical relation with light fields in which they find themselves. Other terms have been used in much the same sense, but often with certain restrictions, or with preconceptions regarding mechanism which it seems best to avoid. The term *tropism* was originally applied to oriented bending, as, for example, in a plant seedling bending toward a light source. The term *taxis* was applied to oriented movement as in a moving animal, for example, an insect. Jacques Loeb (1909, 1918), wishing to emphasize the similarity of orienting mechanisms in plants and animals, included under *tropism* both oriented bending and movement. American zoologists have as a rule followed him in this usage, but among botanists and European biologists in general it is common to distinguish between taxis and tropism. For reasons quite different from those of Loeb, I find the distinction between bending and movement an arbitrary one, as will be explained below. Thus I prefer to use photoorientation in an inclusive sense instead of either phototaxis or phototropism, although habit may lead me at times to employ the latter term.

Phototropism has generally replaced *heliotropism*, the term used by Loeb.

The "tropism theory," or, as it is sometimes called, "Loeb's tropism theory," although once the subject of violent polemic which has not altogether subsided, is seldom clearly defined. There seems to be an underlying concept, however, which when stripped down to its essentials is subject to analysis in simple physical terms. Such an elementary analysis will be attempted in this

paper. It seems, looking back, that neither Loeb and his school nor its opponents ever completed such an analysis. Had they done so much controversy might have been saved, and an extensive literature, much of which is for one reason or another virtually uninterpretable, might not have accumulated.

As applied to photoorientation, I would state the tropism concept somewhat as follows: Where orientation of locomotor organisms in a field of light occurs, it results from the differential stimulation of photosensitive receptors on two sides of some axis if this produces a difference in the effectiveness of locomotor organs on the two sides of that axis. It is not required that the organism have organized eyes, legs, or a highly specialized nervous system. With some change in words but without essential change in meaning we may include in the same category the oriented bending of attached plants and animals. I think such a statement would be generally accepted today by both proponents and opponents of the tropism theory. The idea in this simple form is much older than the present century (see Mast, 1911, or Fraenkel and Gunn, 1940, for historical discussions).

Organisms orient to various other kinds of stimulating fields; gravity, electrical fields, etc. and, although in the present instance we are concerned only with light fields I believe one may find here all the examples necessary for the general application of the tropism concept.

FIG. 1. *Hypotheticus loebi* IN A FIELD OF LIGHT
The arrow indicates the direction of the light rays. The relation of this arthropod to *Machina speculatrix* (Walter, 1950) is not altogether clear.

By way of illustration and amplification of the basic idea, let us consider the animal *Hypotheticus loebi*, shown in Fig. 1. Let us assume that this animal finds itself in a field of light striking it at an angle as shown in the figure. In the position indicated, one of the animal's eyes receives more light than the other, with the result that the legs on the side of the eye receiving the most light move less effectively than the contralateral legs; hence the animal tends to turn so that the principal axis of its body comes into line with the direction of the light rays, the head pointing toward the source. We need not, for the present argument, be concerned as to how this comes about. We may assume that between the photochemical reaction that sets off the stimulus in the eye and the muscular movement of the appendages there is a pathway made up of several neurons. But we may neglect all this and concern ourselves only with the fact that organisms do orient in this fashion, and that the explanation that has been given seems reasonable so far as it goes. We will be concerned principally with an analysis of the kind of paths an organism may be expected to make if these postulates are correct. We will find that some of the widely accepted ideas about the kind of pathways to be expected are not altogether correct, and that sometimes organisms are really behaving in accord with the general concept of tropisms when they make movements that have been interpreted otherwise.

The simple case described for our hypothetical animal, i.e., that with differential illumination the legs on the side receiving the most light move least effectively, would result in the animal's tending to move into a position with its head toward the light. This is generally described, in terms of the tropism theory, as *positive phototropism*. The result is, of course, that, if the animal keeps on walking, he moves as a rule in the direction of the light. Many animals besides *H. loebi* orient in this way. The diametrically opposite orientation would occur if the greater illumination on one side resulted in faster movements of the legs on that side. This would result in the animal tending to turn away from the light. There are many animals that do this, too; they are generally called *negatively phototropic*. In fact, some animals react negatively part of the time, and positively part of the time; change from the one movement to the other is often called *reversal of tropism*. However, observations explained in terms of reversal of

tropism do not always demonstrate what they are supposed to. This brings me to an early naive experiment of my own, which I will describe together with certain others in the order in which they led me to make the analysis that follows.

Some years ago I entertained what I thought a sound hypothesis about reversal of tropism, though I have by now forgotten what it was. In order to test it—by means of an ingenious experiment I have also forgotten—some populations of positively and negatively phototropic organisms from the same species were needed. According to accounts in the literature it should have been possible to find these among small marine crustacea. One summer at the Scripps Institute of Oceanography I attacked the problem. From a plankton haul was obtained what seemed to be an almost pure population of some kind of tiny crustacean. I placed a sample of these animals in a finger bowl, and put it in a beam of sunlight. Almost immediately the population divided into two groups, one in the part of the dish toward the sun, the other in the part away from the sun, as is illustrated in Fig. 2. It seemed that the population was nicely divided into negative and positive organisms, and I was overjoyed, for this was what I had hoped for and had not expected to get so easily. All that now seemed necessary was to separate the populations into two separate dishes. The "positive" organisms were put in one dish, the "negative" in another. But when these dishes were placed in sunlight, in both cases the animals again separated into two groups, some going toward the sun and some going away from it. What was happening was at once apparent. In the round finger bowls the sunlight was focused so that it was most intense in the center of the dish. This region the animals seemed to be "avoiding"—if I may be pardoned an anthropism—by getting into the two regions of the dish where the light intensity was least.

Have not similar observations served in the earlier literature to support wrong conclusions?

I could detect no moving back and forth from one part of the dish to the other; in both groups the animals raced about with no apparent orientation—seemingly at random. Presumably one could have explained this in terms of *photokinesis*, a phenomenon found in some species of organisms which are not observably oriented by light but which speed up their locomotor movements with

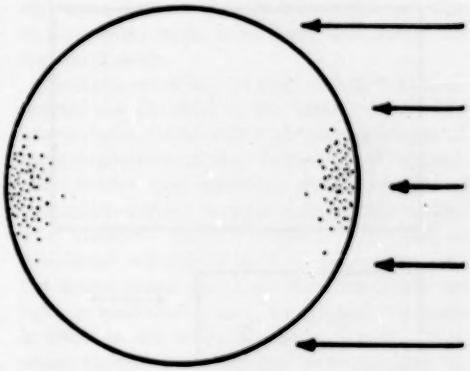

FIG. 2. DISTRIBUTION OF SOME NEGATIVELY PHOTOORIENTING CRUSTACEA IN A CIRCULAR DISH IN SUNLIGHT
The arrows indicate the direction of the sun's rays.

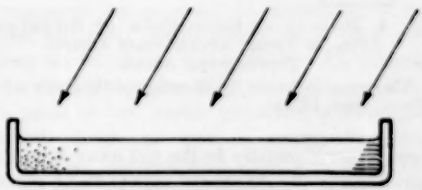

FIG. 3. DIAGRAM OF THE DISTRIBUTION OF *Harpacticus fulvus* IN A RECTANGULAR DISH IN SUNLIGHT, VIEWED FROM THE SIDE
The arrows indicate the direction of the sun's rays. Note that none of the animals are found in the region of partial shade at the end of the dish toward the sun.

increase in light intensity. In a nonuniform light field such animals, being stimulated to move more rapidly in intense light, would appear to flee to the dimmer regions where their movements would become slower. This seems an unlikely explanation, however, in terms of the following studies.

It was some time before I again ventured into this field. In the summer of 1933, at the laboratory of Marine Zoology at Concarneau, I studied the copepod crustacean *Harpacticus fulvus*, a tenacious little beast found in practically pure culture in the pools left by the highest tides of the month. This time, I used rectangular dishes. When such a dish containing the copepods was placed in sunlight, the animals all assembled at the end away from the sun, as indicated in Fig. 3; but at no time did one have the impression that they were oriented with respect to the light field. So far as the eye could judge they moved completely at random, and yet every time the dish was reversed

FIG. 4. DIAGRAM OF DISTRIBUTION OF *Harpacticus fulvus* IN THREE RECTANGULAR DISHES, VIEWED FROM ABOVE

The arrow indicates the direction of the sun's rays. (From Blum, 1934a).

they "drifted" rapidly to the end away from the sun. Superficially this might appear to be photokinesis. But the rays of the sun are virtually parallel, and except for a slight shadow from the glass at the end of the dish toward the sun—where no animals collected—the intensity must have been very nearly the same throughout. My explanation of the behavior of the animals is that they were subject to orientation in the way indicated by the tropism theory, but that they changed their pathways so frequently that this orientation was effectively masked. One had to include an unexplained ***undirected movement*** factor to describe such behavior; but that photoorientation can impose a drift on otherwise random movement seems obvious.

The term ***undirected movement*** is used here and elsewhere in this paper to include movements not primarily determined by orienting factors. The terms random movement and spontaneous movement it seems well to avoid because of possible connotations regarding mechanism.

When acid was added to the sea water, the animals dispersed, distributing themselves nearly equally in all parts of the dish. Such behavior had been previously described for other small crustacea (Rose, 1929), and had been explained by assuming that most of the animals were strongly negatively phototropic to begin with, but that with increase of hydrogen ion concentration a certain proportion became positively phototropic until finally the condition was reached in which there were equal numbers of positively phototropic and negatively phototropic individuals. If this explanation were correct, one would expect that under appropriate conditions more than half the animals might go to the side of the dish nearest the sun. But this did not occur in the experiments reported by Rose, nor in my own with *Harpacticus*.

As a further test of this explanation, the animals were put in larger dishes, with the result diagrammed in Fig. 4. In the smaller dish the animals seemed to be distributed at random, but in the larger dishes they were obviously subject to some negative orientation. This should not have been the case had there been a true reversal of tropism. From these experiments it was concluded that what changed with the hydrogen ion concentration of the medium was not necessarily the degree of orientation of the animals, but the length of the path they traveled before changing direction, say, owing to change in velocity of travel.

This I compared at the time to mean free path of molecules; perhaps a useful though not an exact analogy. Thinking in these terms one may compare the present situation with molecules of a paramagnetic gas in which a drift is imposed by a magnetic field. The random movement of the molecules and the drift imposed by the field are essentially independent factors. Similarly, the undirected movements of *Harpacticus* and the imposed orientation to light can be treated, for analysis, as separate factors.

In the course of the same summer I made observations on the larva of the lobster, *Homarus vulgaris* (also found, if one is fortunate, in the form Homard à l'Armoricaine, improperly called Homard à l'Americaine), which could be readily obtained at Concarneau. These animals, unlike *Harpacticus*, orient themselves quite exactly along the path of the light rays, but in a somewhat unorthodox manner. When first placed in strong sunlight they swim tail foremost toward the sun, but after a time swim head foremost away from the sun. Fig. 5 shows the difference in position in the two cases. The head is always oriented in the same direction, but the body, when the animals are retreating from the sun, is curved in the manner shown, whereas when moving toward the sun the body is extended. The difference in the direc-

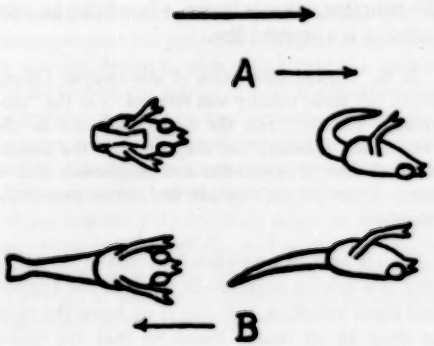

FIG. 5. POSITION ASSUMED BY THE LARVA OF *Homarus vulgaris* IN A BEAM OF PARALLEL LIGHT RAYS

A, Position when moving away from the source. B, Position when moving toward the source. The large arrow indicates the direction of the light rays. The small arrows show the direction of movement. (From Blum, 1934b).

tion of movement is associated with this change in position, which also changes the effective direction of stroke of the swimming appendages (Blum, 1934b). This animal, then, changes its direction of movement without changing its orientation.

It seems clear that for adequate description orientation must be separated from direction of progression, and if so there are at least four main possibilities instead of two, as suggested in Fig. 6. Indicated at the top is an animal moving head first away from the light—this would correspond to what is commonly called negative phototropism. This might better be described, however, by saying that the sign of orientation is negative but the sign of progression is positive, if we arbitrarily call head-first progression positive. The next type of movement corresponds to what is commonly thought of as positive phototropism, where the sign of orientation is plus and the sign of progression plus; the animal moves head first toward the light. In the third case the animal moves tail first away from the light—it is positively oriented but progression is negative. In the last case the animal moves tail first toward the light—orientation is negative and progression is negative. There is of course much arbitrariness in this classification. For example, it may be difficult to fit the manner of movement and orientation of *Daphnia*, which swims more or less "upright" (see, for example, Clarke and Wolf, 1932), into this scheme. However, it must be clear that a distinction between sign of orientation and sign of progression needs to be made, and this is the important point.

Examples of all but the third case in this classification are described in the pr sent paper. The lobster larva follows either the first or fourth of these possibilities; reversal of direction of displacement in this case represents reversal of sign of progression without reversal of sign of orientation. The "classical" type of reversal is reversal of orientation without reversal of progression, i.e., the animal either goes head first away from the light or head first toward the light. An example is found in the beetle *Dineutes assimilis* which, when dark-adapted, changes from positive to negative orientation without change in sign of progression (Raymont, 1939).

Now, having through these observations recognized the necessity of separating orientation and progression for purposes of description, I saw what—it now seems—should have been clear from the beginning: that to analyze the pathway of a moving animal one has to treat that pathway in terms of two vector quantities, a *progression velocity component* and an *orientation velocity component*, corresponding to the linear velocity and the angular velocity into which one analyzes the pathway of any moving particle. Let us return to our hypothetical animal. According

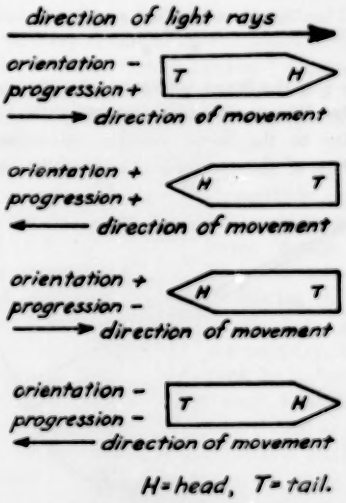

FIG. 6. DIAGRAM OF FOUR TYPES OF ORIENTATION-PROGRESSION BEHAVIOR

H, head; T, tail. (From Blum, 1935).

to the theory of tropism, as I have outlined it, the animal, owing to the effect of differential illumination on its two sides, will tend to turn until it becomes equally illuminated on both sides. If it travels forward in so doing it may be expected to follow a path like the one in Fig. 7, the curvature of which becomes less as the animal approaches alignment with the direction of the light rays. To describe such a path quantitatively one may think of it as made up of a series of segments of circles of varying radii. The beginning of the pathway drawn is approximately described by the arc which has the length s; the radius of this arc is r, and the angle subtended is ϕ. A little farther along, the curvature is less and the radius r' longer. In the notation of radians we may write

$$\phi = \frac{s}{r} \qquad (1)$$

or, for convenience,

$$\frac{1}{r} = \frac{\phi}{s} \qquad (2)$$

That is, the curvature is characterized by the reciprocal of the radius. If we think of the animal traveling over such a path, we may analyze its movement into two velocities, a linear velocity and an angular velocity. In unit time the animal travels over the distance s and in the same unit of time through the angle ϕ. So we may write

$$\frac{1}{r} = \frac{\omega}{v} \qquad (3)$$

where v is the linear velocity and ω the angular velocity. We may say that the ratio of the angular velocity to the linear velocity determines the *curvature* of the pathway at any given instant.

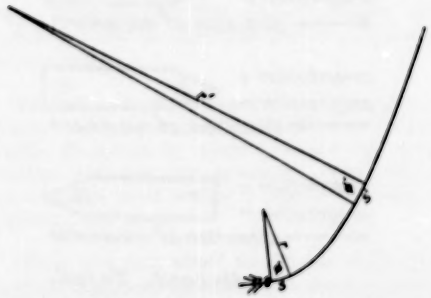

FIG. 7. SCHEME FOR DESCRIBING PATHWAY OF A PHOTOORIENTED ANIMAL
See text.

We note that, when ω is zero, r is infinite, i.e., the pathway is a straight line.

In the original publication of this analysis (Blum, 1935), the linear velocity was referred to as the "progression velocity," and the angular velocity as the "orientation velocity," in keeping with the assignment of signs of orientation and progression. But it seems better to use the physical terms commonly employed.

We are now in a position to describe the pathway of a moving organism in terms of the angular and linear velocities, but only if we know the ratio of these at all times. Assuming that the linear velocity is constant, the angular velocity must be expected to change as the animal changes its position in the light field, because the difference of illumination on the two sides of the animal depends upon its position with regard to the light rays. The differential effect of illumination depends not only upon the geometry of the light field, but also upon the geometry of the receptor organs and of the locomotor appendages and in addition upon the pattern of whatever connecting links there are between the responses of receptors and appendages. This is obviously not an easy thing to analyze, because we should need to know a great deal more than we do, or are very likely to find out.

The geometry of even the simplest organisms is so complex that it seems better to substitute a mechanical model in order to understand the factors underlying photoorientation. Let us construct such a model. The one diagrammed in Fig. 8A is supposed to represent a machine with two

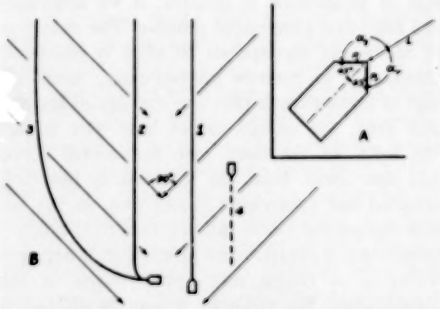

FIG. 8. A, DIAGRAM OF A MECHANICAL MODEL TO ILLUSTRATE ORIENTED MOVEMENTS. B, PATH THE MODEL SHOULD FOLLOW IF PLACED IN A FIELD OF TWO PARALLEL BEAMS OF LIGHT CROSSING AT RIGHT ANGLES
See text for explanation.

flat-surfaced photoelectric cells P_l and P_r, so arranged that the photocells compete in operating a steering device in such a way that the machine turns toward the side of greater illumination. For simplicity we may assume that the angular component given to the steering device by each photocell is directly proportional to the amount of light falling upon that photocell in unit time. We think of an angular velocity component to the right, α_r, given by photocell P_r, and an angular velocity component to the left, α_l, given by photocell P_l. The angular velocity of movement of the machine, may then be represented by

$$\omega = \omega_r - \omega_l \tag{4}$$

When the photocells are equally illuminated, ω is zero, i.e., movement is in a straight line. When the model is placed in a beam of light, the angular velocity component is, within certain limits, a simple function of the angle which the photocells present to the beam.

It is obvious from the diagram that there are certain positions in the light field in which either P_r or P_l, or both, receive no light, so that the corresponding angular components become zero.

Namely,

$$\omega_r = k \sin \alpha_r \tag{5}$$

and

$$\omega_l = k \sin \alpha_l \tag{6}$$

hence

$$\omega = k (\sin \alpha_r - \sin \alpha_l) \tag{7}$$

where k is a constant. We must also specify the sign of the angular component given by the steering apparatus. This determines whether the machine orients positively or negatively. If, as described above, we arrange that the illumination of P_r steers the machine to the right and illumination of P_l steers the machine to the left, the machine will tend to orient toward the source of the light rays; i.e., it is "positively orienting." The reverse arrangement would result in negative orientation.

The model seems to present essentially the conditions described above as being basic to the tropism theory as illustrated with *Hypotheticus loebi*. The only difference is that in that imaginary organism or in any real one we should have to replace Equation (7) by

$$\omega = f_r(\alpha_r) - f_l(\alpha_l) \tag{8}$$

where the functions f_r and f_l may be very complicated ones, even in the simplest cases we may choose.

The behavior of our model when it finds itself in various kinds of light fields may now be studied, after which it will be possible to make comparisons with the behavior of some real animals in similar fields. For simplicity let it be assumed that the linear velocity of the model is independent of the steering device and is constant at all times. Thus v may be taken as unity, and, if an arbitrary value is assigned to k, the pathway of the model may be plotted. This pathway will depend on the geometry of the light field and the position in that field from which we begin to trace the movement.

Let us examine the behavior of the machine arranged for positive orientation and placed in the field made by two parallel beams crossing at 90°, as indicated in Fig. 8B. If the model is aligned exactly along the resultant of the two light beams, as indicated at 1, both the photocells receive the same illumination and the path should be a straight line following a resultant of the two beams. This is the kind of pathway that seems to be tacitly expected from the tropism theory. But if the model is placed at an angle to the resultant, as for paths 2 and 3, it should follow the curves indicated. The difference in the latter two cases is that a different value has been assigned to k; for curve 2, $k = 1$; for curve 3, $k = 0.14$. The linear velocity v is taken as unity in both cases. An animal following a pathway similar to curve 2 would commonly be said to display "strong tropism." A curve such as curve 3 might be characteristic of a "weak tropism." Our analysis gives partial quantitative meaning to these qualitative terms.

There is another situation to note. If the model were placed so that it was negatively oriented along the resultant of the light beams, as is indicated at 4, then no light would impinge upon either photocell. The animal should behave as though negatively oriented, following the path indicated by the broken line in the figure. But it must be remembered that the pathways drawn are such as might be described by a "perfect" model. In a real model there would be some play of the steering gear, and a slight roughness of the terrain would cause a certain amount of undirected movement.

For explanation of this term, see p. 310.

So the model would not be expected to follow a path such as 4 for very long; once it diverged

from that path it would be oriented gradually in the positive direction. Such undirected movement would, of course, tend also to modify the other pathways to a certain extent. It has already been seen that undirected movement is characteristic of at least some organisms, and it may be assumed that undirected movement always complicates the path of a photooriented organism to a certain extent. We shall have more to say about the nature of undirected movements a little later.

Let us now examine the pathways made by some real animals when placed in situations analogous to those assumed for the model. Fig. 9 shows the behavior of 11 individuals of the cucumber beetle, *Diabrotica soror*, when introduced into the field of light from two sources placed at such a distance that the animals are virtually in the kind of field described in Fig. 8B, i.e., two beams of approximately parallel rays impinging at an angle of 90°. For the most part these animals follow the resultant fairly well, although 3 of the 11 deviate considerably therefrom. All in all, their behavior is not unlike what we might expect from our model if the ratio $\frac{\omega}{v}$ is not too high, and if there is some undirected movement.

Fig. 10 shows pathways followed by 9 garden snails, *Helix aspera*, when placed under the same conditions; there is more undirected movement in these pathways, but again the animals behave much as the mechanical model might be expected to do.

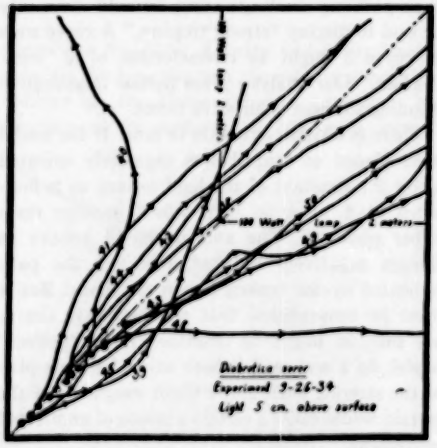

FIG. 9. PATHS FOLLOWED BY INDIVIDUALS OF THE CUCUMBER BEETLE, *Diabrotica soror*, IN THE FIELD OF TWO APPROXIMATELY PARALLEL BEAMS OF LIGHT CROSSING AT 90°

(From Blum, 1935).

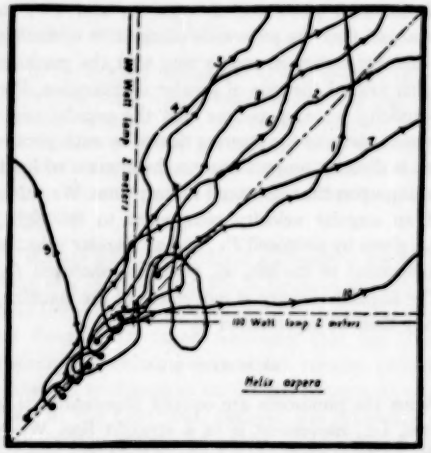

FIG. 10. PATHS FOLLOWED BY INDIVIDUALS OF THE GARDEN SNAIL, *Helix aspera*, IN THE FIELD OF TWO APPROXIMATELY PARALLEL BEAMS OF LIGHT CROSSING AT 90°

(From Blum, 1935).

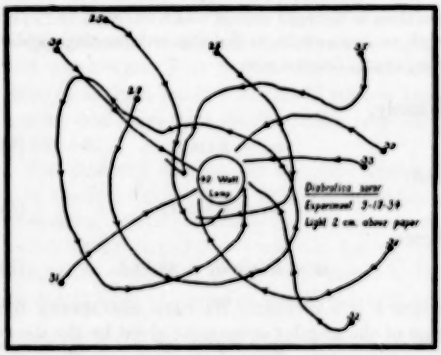

FIG. 11. PATHS FOLLOWED BY INDIVIDUALS OF THE CUCUMBER BEETLE, *Diabrotica soror*, IN THE FIELD OF A SINGLE LIGHT SOURCE

(From Blum, 1935).

Let us now examine the behavior of individuals of the same two species when placed in another kind of light field, the rays around a single source. Fig. 11 shows pathways made by individuals of *Diabrotica soror*; Fig. 12, some made by individuals of *Helix aspera*. It is noted that both *Diabrotica* and *Helix* often tend to follow spiral paths around the source, at other times they may go directly toward it.

Now our mechanical model should behave in

much the same way, as is indicated in Fig. 13. The conditions assumed there are the same as for curve 3 in Fig. 8B, that is, $v = 1$, $k = 0.14$. The path followed is quite different for different initial positions of the model in the light field. It may go directly toward the light, as does path 6, or spiral about it as does path 3, or it may follow a curved course such as path 3. If the machine is oriented along a circle of a particular radius (path 1), the machine should continue to circle around the source, always at the same distance. The radius of this circle is determined by the values of k and v. To follow this circle indefinitely there must be no undirected movement.

Another assumption needs to be mentioned, that the increase in light intensity as the source is approached may be neglected. While this is not rigidly true it should be nearly so, because the steering depends upon the differential illumination of the two photocells, not on intensity *per se*. Other minor simplifications have been made in order to trace the pathways graphically, but the effect of these is negligible in any general sense.

If Figs. 11 and 13 are compared, a remarkable resemblance is found in some of the curves; those in Fig. 12 show more undirected movement, but again the tendency to move in spirals is clear, with an animal moving now and then quite directly toward the light, just as the model would be expected to do.

It is seen from the model that animals, although positively oriented, may be expected to move at times in paths which carry them away from the light source. Path 3 in Fig. 13 is an example; the model spirals toward the source up to a certain point, then moves away from the source, soon arriving at a position where light no longer strikes either photocell. After this the model continues in a straight path which carries it away from the source, as indicated by the broken line in the figure. At night it is not uncommon to see insects spiral toward a source of light and then fly away from it again without any sharp change in path. This is sometimes thought to represent reversal of tropism, but it is seen from the model that there is no need to assume that reversal occurs in these cases. If it behaves as the model does, the animal might spiral into the light and then fly away from it without changing either its linear velocity or its characteristic orientation; and even though the animal were moving in a close spiral that would bring it to the lamp, a slight increase of linear velocity could carry it away again. There seems no reason at all to interpret this type of behavior as involving reversal of sign of orientation.

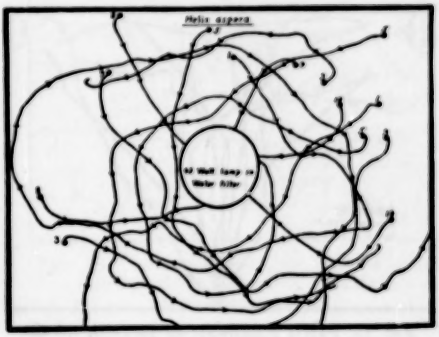

FIG. 12. PATHS FOLLOWED BY INDIVIDUALS OF THE GARDEN SNAIL, *Helix aspera*, IN THE FIELD OF A SINGLE LIGHT SOURCE
(From Blum, 1935).

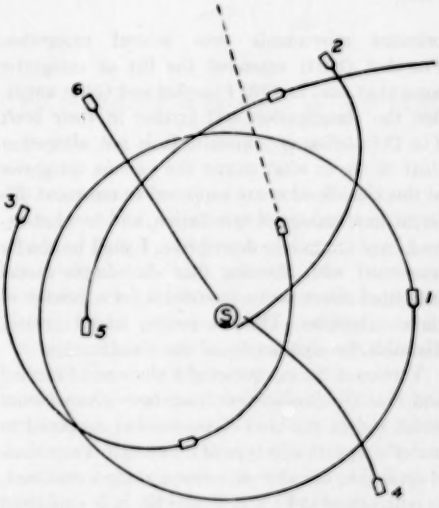

FIG. 13. PATHS WHICH THE MODEL ILLUSTRATED IN FIG. 8,A SHOULD FOLLOW IF PLACED IN THE FIELD OF A SINGLE LIGHT SOURCE (S)
$k = 0.14$, $v = 1$.

It has been seen that pathways made by the same model are quite different in light fields of different geometry, and that this is also true for real animals. It will be interesting to see how this relates to attempts that have been made to classify the behavior of animals according to the types of pathways they describe in light fields of different geometry. Kuhn in 1919 attempted this, dividing

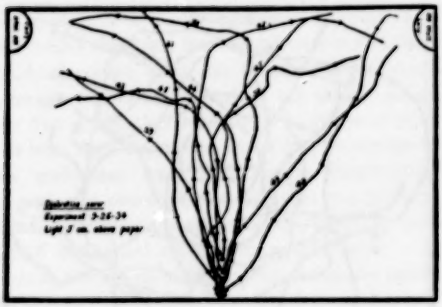

FIG. 14. PATHS FOLLOWED BY INDIVIDUALS OF *Diabrotica soror* IN THE IMMEDIATE VICINITY OF TWO LIGHT SOURCES

Area of experimental surface, 75 cm × 50 cm. The paths shown in this and in Fig. 9 were made by the same individuals, as indicated by the numbers. (From Blum, 1935).

oriented movements into several categories. Fraenkel (1931) extended the list of categories somewhat, and in 1940 Fraenkel and Gunn amplified the classification still further in their book *The Orientation of Animals*. It is not altogether clear to me to what extent the various categories of this classification are supposed to represent different mechanisms of orientation, and to what extent they are purely descriptive. I shall be chiefly concerned with showing that the simple model presented above seems to account for a number of these categories. This, it seems, would greatly diminish the significance of the classification.

Various of the categories of Kuhn's and Fraenkel and Gunn's classification have been given names which reflect the kind of mechanism supposed to underlie a particular type of movement. Tropotaxis is applied to oriented movement along a resultant, as represented in Figs. 8, 9, and 10; it is explained by essentially the same mechanism involved in our model. Spiral movements are placed in another category, menotaxis, the mechanism assigned being based on the findings of von Buddenbrock. The latter suggested (1917, 1919) that some animals on entering a light field become oriented at a certain angle to the light rays and tend to maintain this orientation so long as they remain in the light field. Von Buddenbrock applied the term "Lichtkompassbewegungen," for which the term menotaxis was chosen as synonymous. The mechanism assigned by von Buddenbrock would presumably bring an animal in a spiral path either toward the light or away from it depending upon the angle to which the orientation of the animal became set. But in the case of *Diabrotica* and of *Helix* the pathways under such circumstances seem better explained in terms of our mechanical model. Von Buddenbrock's explanation probably holds in other cases, as suggested by other types of experiments.

Some such mechanism as von Buddenbrock's seems needed to explain the orientation of bees to the polarization of sky light, discovered by von Frisch (see 1950).

But—and this is the point to emphasize—it might be difficult to decide between these two mechanisms if the type of pathway followed in the field of a single light source were the only criterion.

Our model would seem to explain yet other of the categories of pathways in the Kuhn-Fraenkel-Gunn classification, for example, "telotaxis," or oriented movement toward a goal. Supposedly, in this type of orientation the animal fixes the image of a certain source of light on its retina and moves toward that source. If presented with two sources, it will accept one or the other and move toward it. In Fig. 14 are shown pathways followed by *Diabrotica soror* when placed near the resultant of the fields from two sources. Some of the animals tend to go directly toward one source or the other; but the greater number move along the resultant for some time before they break away and move toward one source. It will be noted that most of the animals tend to break away from the resultant at about the same point. Our mechanical model might be expected to behave in a similar fashion. Started along the resultant, it would follow this closely, provided it did not make too many undirected movements. But if a random turn placed it so that one of the sources illuminated neither photocell, it would then proceed toward the other source. As it proceeded along the resultant, a point would be reached where a very slight turn would release it from the influence of one of the sources of light; here it would be most likely to break away; but it might break away either before or after that point was reached. When we examine the arrangement of the eyes of *Diabrotica* (Fig. 15), we see that their geometry is such that the animal might be expected to behave in a manner similar to that of the model. The two compound eyes are each composed of a relatively small number of ommatidia, each of which subtends an angle of 12° to 15°. Placed on the resultant at the point where most of the curves break away, in Fig. 14, the animal need turn only slightly toward one source to be no longer stimu-

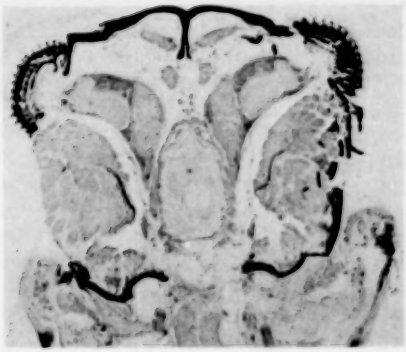

FIG. 15. FRONTAL SECTION THROUGH THE HEAD REGION OF *Diabrotica soror*, SHOWING THE POSITION OF THE TWO COMPOUND EYES
(Sections made by Charles Wilson. Photomicrograph through the courtesy of Professor Roderick Craig.)

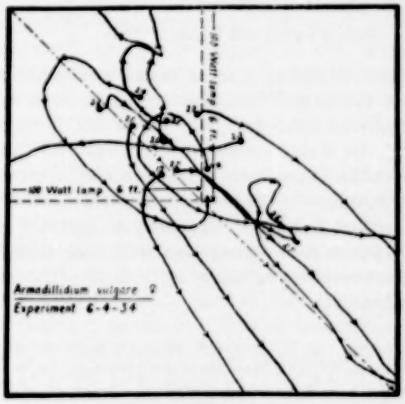

FIG. 16. PATHS FOLLOWED BY INDIVIDUALS OF *Armadillidium vulgare* IN THE FIELD OF TWO APPROXIMATELY PARALLEL BEAMS OF LIGHT CROSSING AT 90°
(From Blum, 1935).

lated by light from the other, which would not now enter any of the ommatidia.

The examples which have just been discussed involve two species of positively orienting animals. Let us now consider the behavior of two negatively orienting species having a positive sign of progression, i.e., tending to move head first away from the light. Figure 16 illustrates the behavior of several individuals of *Armadillidium vulgare*, a small isopod crustacean, in the field of two approximately parallel beams crossing at right angles. Most of the animals tend to follow the resultant in

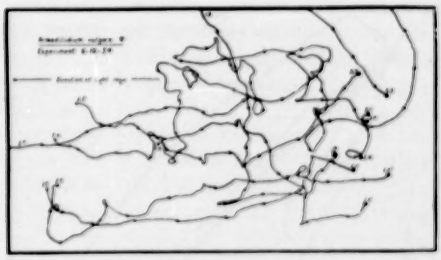

FIG. 17. PATHS FOLLOWED BY INDIVIDUALS OF *Armadillidium vulgare* IN SUNLIGHT
(From Blum, 1935).

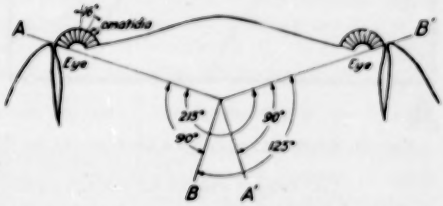

FIG. 18. DIAGRAM OF FRONTAL SECTION OF HEAD OF *Armadillidium vulgare*
(From Blum, 1935).

the direction away from the sources of the rays, a behavior which would seem to place their behavior in the category of tropotaxis according to the Kuhn-Fraenkel-Gunn classification. But when placed in the parallel rays of sunlight, as shown in Fig. 17, the behavior of these animals seems to fall into another of their categories, phobotaxis, characterized according to Fraenkel (1931) as "ungerichtete Orientierungsbewegung." Most of the pill bugs move away from the sun, as would be expected, but they follow devious courses in doing so. The frontal section of the head of *Armadillidium vulgare*, diagrammed in Fig. 18, helps to explain this behavior. The animal has two small compound eyes, each consisting of a few ommatidia, and both pointed quite directly head on. Thus, when the light is behind it, the animal can turn through a wide angle without either eye being illuminated. When it does turn so as to receive illumination on one eye, it tends to be oriented so that it goes away from the source of light, but there is a great deal of freedom in its orientation. The behavior of *Armadillidium* in sunlight is reminiscent of that of *Harpacticus*. We might almost say in looking at the set of tracks in Fig. 17 that the animals were moving at random, and yet on a statistical basis they do move away from the sun.

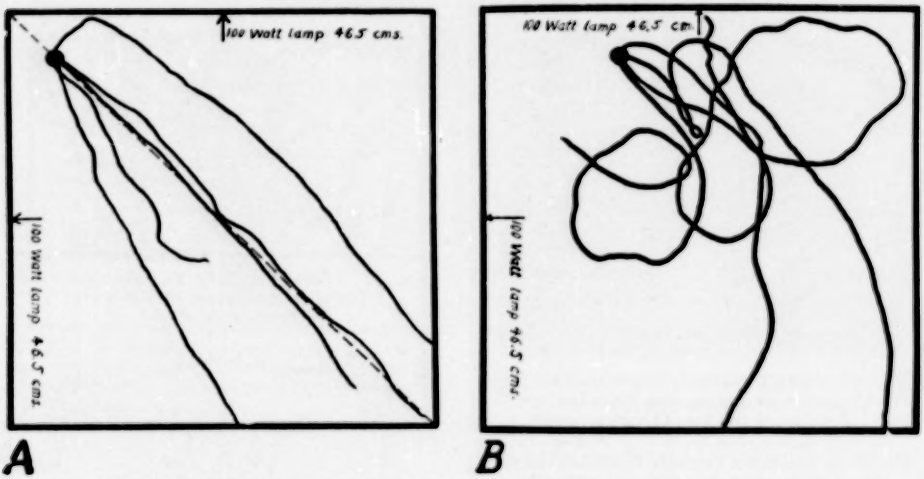

FIG. 19. PATHS FOLLOWED BY INDIVIDUALS OF *Planaria gracilis* IN A FIELD OF TWO APPROXIMATELY PARALLEL BEAMS CROSSING AT RIGHT ANGLES

A, Animals well fed. B, Animals starved. (From Blum, Hyman, and Burdon, 1936).

The flatworm *Planaria gracilis* is another negatively orienting organism. Fig. 19 shows some pathways of these animals in the field of two lamps placed at some distance. Well-fed animals (19, A) follow the resultant fairly well with negative orientation. Starved animals (19, B) show a good deal more undirected movement. The latter tend to go in the general direction indicating negative orientation, but move in wide circles which may effectively obscure their orientation.

Photokinesis has already been mentioned. The term is one of long standing which has been incorporated into the Kuhn-Fraenkel-Gunn classification. Presumably this term describes an increase in the linear velocity with increase in intensity of the illumination. Such a mechanism might be regarded as a factor independent of orientation. If an organism displayed photokinesis without photoorientation, it would in a heterogeneous light field tend to get into the regions of lowest intensity. This explanation has been offered in various instances. It has been pointed out, however, that such a mechanism could not explain the behavior of *Harpacticus* although one might at first be tempted to apply it. No doubt negative photoorientation, when superimposed on a good deal of undirected movement, has often been described as photokinesis. Loeb attributed the behavior of *Planaria* to photokinesis, and it is seen from Fig. 19 B how easily this impression might be gained from observing starved animals. I have measured the rate of travel of these worms in diffuse light from above and found no change in rate with changes of light intensity. Welsh (1933) found, similarly, that a number of marine invertebrates, which like *Planaria* move by means of cilia, showed no photokinesis; whereas others, which moved by means of locomotor appendages operated by muscles, showed photokinesis. One may think of photokinesis operating in an animal which also photoorients.

In the case of *Diabrotica soror* extensive measurements by Willis G. Watrous in my laboratory at Berkeley failed to reveal any consistent change in rate of travel as the animals passed through a wide range of intensities in approaching a point source.

Where this occurred, one more difficulty would be placed in the way of the analysis of the pathways, since the curvature must depend upon the linear as well as the angular velocity.

We come now to the problem of undirected movements, which is perhaps one of the most difficult encountered, both from the standpoint of experiment and from that of analysis. An animal like *Harpacticus* changes its path so frequently and so suddenly that the orientation is effectively masked. Change in direction means sudden curvature of pathway and may be thought of as involving a change either of angular or of linear velocity. If our mechanical model were moving rapidly and were suddenly slowed down without interfering

with the steering apparatus, the pathway should tend to curve sharply so as to bring the animal more rapidly toward orientation with the light field. On the other hand, a sudden change in the orienting characteristics, e.g., change in the constant k of the mechanical model, would also lead to sudden change in direction of the pathway. It is clear from a consideration of the model and particularly from an examination of Fig. 13 that the pathway followed during a short interval of time should depend among other things upon the organism's position at the beginning of that interval. Thus any undirected movement which suddenly changes the position of the organism with respect to the light field may bring about a pronounced change in the apparent character of the subsequent path. This is clearly demonstrated in Figs. 11 and 12, where the type of movement of *Diabrotica* and *Helix* around a single source changes in character from time to time, presumably because of sharp "undirected" changes in position of the animal with regard to the light field. It seems obvious that a study of the pathways alone would not lead far toward understanding the mechanism of these apparently undirected changes.

There are various types of apparently undirected movement characteristic of given species. A well-known example is the so-called "avoiding reaction" of *Paramecium*, a type of motion that seems determined in part by the asymmetry of that animal. Some species of animals characteristically turn the head from side to side in a more or less rhythmic fashion as they proceed; some tend to "roll" on their long axis. Considering all these possibilities, the question of nonoriented movement introduces a complicating, and never completely negligible, component into the study of the behavior of organisms. The term *klinotaxis*, which Fraenkel and Gunn (1940) have introduced, would presumably include such factors, to which it seems very difficult to apply a common analysis.

It was intimated earlier that the distinction between tropisms and taxes is an artificial one, and this point should now be examined. The botanist characteristically applies the term tropism to the bending of an attached plant, for example, the bending of the oat coleoptile toward a source of light. But this bending is in reality a movement which needs to be described in terms of two velocities, a linear velocity represented by the forward component of growth of the coleoptile and an angular velocity which is induced by the light. In this case the linear velocity is very low and the orientation is correspondingly exact; so it is not surprising to find the seedlings bending along a line of equal intensity if placed in the field of two sources of light. For example, in a field such as that described in Fig. 8 B the bending would follow path 1 closely. Fraenkel and Gunn (1940, p. 141) have presented equations which describe the line of equal light intensity in the field of two unequal light sources, and Loeb (1918, p. 80) did the same thing in a less elegant fashion. This line is the one along which a photoorienting plant coleoptile or any attached organism might be expected to bend. But contrary to what these authors apparently expected, this is not the path likely to be taken by a fast-moving animal, for which the ratio $\frac{\omega}{v}$ would generally be low. It may be pointed out that the behavior of an attached form in orienting itself into a position of equal intensities is really only a special case of the general concept outlined above—that is, one in which the ratio of angular velocity to linear velocity is very high. If this ratio is low, as it is likely to be in rapidly moving animals, then we cannot expect this type of pathway to be followed.

The model and all the organisms, hypothetical or real, that have been considered up to this point are bilaterally symmetrical, and have been discussed only in terms of their orientations in the plane of their axes of symmetry. Often in the past the objection has been made that such a treatment does not apply to organisms which are not bilaterally symmetrical, or which show orientation in some plane other than that of their bilateral symmetry. For example, a flying insect may orient in a vertical plane in relation to a light source. Orientation of a bilaterally symmetrical animal is certainly the simplest type for study, but the same method of analysis of the curvature of pathways should apply elsewhere. There is no reason why one cannot use, for analysis, an imaginary axis as well as a real one, and, to be sure, any axis we may choose is to a certain extent an imaginary one.

For example, according to von Buddenbrock's explanation of light compass movements, the animal presumably orients about an axis which is initially determined by conditioning events.

There are a good many other factors which may affect the orientation of organisms in light fields.

The light intensity factor has usually been disregarded in the present analysis. In many cases it should be possible to do this if the organisms behave more or less like our mechanical model, in which the steering depends upon differential illumination of two opposed photocells and so is virtually independent of intensity *per se*. But intensity no doubt plays a role in some cases. And this brings up another question, that of the adaptation of the organism to light, which will not be discussed further than to point out that if the photocells in our model were the kind subject to "fatigue," i.e., if they became less sensitive with continued exposure to light, the model should mimic some of the experiments that have been carried out on animals (e.g., Cole, 1923). We need also to consider the possibility of some learning on the part of animals placed repeatedly in given experimental conditions.

Because of the differential nature of the stimulus in our model, there is no true "threshold" of orientation, any apparent threshold effect depending chiefly upon our ability to observe orientation. Thus, regarded in terms of the model, it is not surprising that orientation to very low intensities is sometimes observed (e.g., Bonner et al., 1950).

When we take such factors into consideration in addition to those mentioned earlier—and we may need to include still more (see, for example, Tolman, 1939)—the prediction of the pathway which an organism will follow becomes extremely difficult. The only way we can hope to do so is by eliminating as many of these factors as possible. This is really what is aimed at in most experiments designed to study photoorientation.

This leads to a consideration of the implications of such studies. Behavioristic psychology had its roots in the study of oriented movements (see the address by Loeb before the 7th International Psychological Congress in Geneva, 1909) and we may ask ourselves whether the interpretation of stereotyped responses of this type has not had an important, though often tacit, influence on our ideas regarding all aspects of animal behavior, including that of man. To what extent do oriented movements form a part of the pattern of animal behavior? In this regard we have to remember that the experiments we set up usually place the animal in a situation very unlike the environment in which it ordinarily finds itself and to which it may be expected to be reasonably well fitted as regards its behavior. For example, in the experiments on *Diabrotica* and *Armadillidium*, which have been described, care was taken to eliminate from the field of vision any object within the animal's visual acuity (as based on the dimensions of the ommatidia), other than the lamps which provided the orienting light field, and so far as known all other sensory cues. Is this not really simplifying the situation to such an extent that the normal behavior of the animal is effectively destroyed? What we try to do in this kind of experiment is to bring the animal into such a situation that its behavior will not be much more complicated than that of a mechanical model. Such an objection does not mean at all that orientation may not be a useful tool for analyzing sensory mechanisms, and other parts of behavior. It simply means that we should not consider the oriented movements made by an organism as representative of the behavior of that organism in a more usual environment.

I would not wish to deny that photooriented movements may form part of the behavior pattern of many living organisms. For example, the negative orientation of *Armadillidium* and *Planaria* would seem to take them away from unfavorable environmental conditions. On the other hand, I surmise that more commonly the photooriented response that can be shown in the laboratory has little significance as regards the organism's normal behavior or its adaptation to its environment. The positive phototropism of *Diabrotica* seems of doubtful behavioral significance. In some plants photoorientation may, by placing the leaves so as to receive the maximum amount of sunlight, increase photosynthesis and so be advantageous to the plant. But in the case of the oat seedling, on the other hand, the effect is to place the leaf so that it receives least light. A good example of a photoorientation which appears to be only an accidental happening is the phototropism in plant roots, such as may be observed in the mustard seedling. It seems hard, too, to see how the photoorientation of *Harpacticus* is of much importance in its behavior.

Perhaps we should look at the matter in the following way. The property of orienting to a light field may only reflect some heritable "accident" of anatomy. For example, some minor difference in arrangement of sensory mechanisms or neural pathways might result in, say, positive

photoorientation of an organism. These anatomical relations would, of course, be inherited, but they might have little initial significance regarding an organism's adaptation to its environment. At some point in its evolution, however, orientation to light might become coordinated into a behavior pattern and, if this offered a handle for natural selection, might become an essential characteristic of the species, necessary to its survival.

Much of the polemic which once characterized this subject was involved with the issues of mechanism vs. vitalism, or free will vs. determinism. But does the demonstration of photooriented movements really have much significance in this regard? The mere demonstration than an animal may behave like a simple machine when placed in a very simplified situation does not seem pertinent. We may for good reasons wish to put the animal in such a situation and to observe its behavior as a simple machine rather than as a very complicated, and hence less predictable, one. But this does not to my mind answer any metaphysical questions.

Speaking of machines, it may be recalled that Jacques Loeb (1918) was much impressed by a machine built by an engineer, Mr. J. H. Hammond, which seems to have been in principle much like the mechanical model so often used in this discussion. Walter (1950) has recently constructed another model which appears to behave similarly in certain respects. A machine in which such factors as ω, v, sign of orientation, and amount of undirected movement could be controlled at will might help in the general solution of many problems by allowing us to test various parts of the photoorientation complex, one at a time, more easily than can be done in an intact animal or by an approximate mathematical analysis. We would have to be careful to remember, of course that we were dealing with a machine and not with living organisms, but perhaps this might be less misleading at times than observations of real animals under very artificial conditions.

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FAUNAL REALMS, REGIONS, AND PROVINCES

By KARL PATTERSON SCHMIDT

Department of Zoology, Chicago Natural History Museum

THE partition of the world into faunal regions, defined as corresponding with a considerable uniformity and distinctiveness of the animal life of each area in question, was the major preoccupation of animal geography for more than fifty years, from about the year 1850 to the end of the century. Lists of species, genera, families, and orders were drawn up for each region. Characteristic animal types, widespread species or genera on the one hand and diversified larger groups on the other, were discerned as index forms. After preliminary partition of the world, more especially of its land surfaces, into larger or smaller regions that seemed to have a somewhat uniform animal life, readjustments of their definitions and of the boundaries proposed for them became the principal topics of discussion among zoogeographers. There arose a large literature in which the faunal affinity of one region or province with another was tested by comparison of the growing and changing lists of genera and species. Such affinity was weighted according to the rank and the zoological relations of the characteristic groups. It must be mentioned parenthetically that such discussions became obsolete with changed and improved ideas of the classification in question. A natural step led to the further controversy as to the rank or equivalence of the regions proposed and thus to a hierarchy of Realms divided into Regions, and these in turn into Subregions and Provinces.

The adjectival names of such faunal areas, of whatever rank, have a double currency, on the one hand for the area and on the other for the fauna characterizing it. Many of the terms that came into early and widespread use in both senses, like Neotropical Region and Neotropical fauna, are still widely current in descriptive zoological literature. They appear of necessity in most studies of the geography of animal life, no matter how much reoriented toward the dynamics and history of dispersal. A current review and set of references for this fund of zoogeographic terms seems to be needed, to judge from conversations with my younger colleagues, and this is attempted in the present paper. Some recent rearrangements within the hierarchy and some recent discussions of transitional areas will be set forth or referred to; but their elaboration is reserved for treatment in another connection.

Discussion of the modern zoogeographic partition of the oceans is not necessary here, since this is provided by the excellent *Tiergeographie des Meeres* by Sven Ekman (1935), now available in an English translation, *Zoogeography of the Sea* (1953). It is to be regretted that the English work omits no less than 123 of the 244 fine maps and figures of the original.

Woodbury, in his recent *Principles of General Ecology* (1954), has devoted a chapter to zoogeography and has listed and mapped the realms and regions. Much the best reference for the definition of these geographic concepts remains Wallace's *Geographical Distribution of Animals* (1876), with its colored maps of the world and of each region.

HISTORICAL CONSIDERATIONS

Before the date of the *Origin of the Species* a few attempts had been made at the discussion of the principles of animal distribution. William Swainson, in his *Treatise on the Geography and Classification of Animals* (1835), arranged animals according to their occurrence on five continents. A more critical division of the continents according to climatic zones, with lists of the mammals, birds, and reptiles then known, was presented in 1841 by Hermann Pompper of Leipzig. Johann A. Wagner, the Bavarian mammalogist occupied with the completion of the first great post-Cuvierian account of the Mammalia, summarized the geographic distribution of this group in a compre-

hensive paper published in 1844–1846. It is interesting to find, in his general introduction, how literally he was bound by the idea of Mt. Ararat as the center of dispersal of all modern animal life.

Ludwig Schmarda's general work (1853), under the title *Die geographische Verbreitung der Tiere*, devoted an introductory section to what would now be regarded as the framework of ecological animal geography—the influences of temperature, light, air, climate in general, etc. This is inadequate mainly because of the inadequacy of knowledge of the supporting sciences at the time. He went on to subdivide the world into faunal regions, after noting the nontaxonomic but essential primary division of the treatment into separate sections for land or air-breathing animals and aquatic or water-breathing creatures. He divided the world into 21 land and 10 marine "realms," which were arbitrarily and somewhat casually defined.

Schmarda's land realms are:

I. The Polar Region
II. Central Europe
III. The Caspian Steppe
IV. Central Asia Proper
V. The Mediterranean Region
VI. China
VII. Japan
VIII. North America
IX. The Sahara
X. West Africa
XI. Africa in general
XII. Madagascar
XIII. India
XIV. The Sunda Region
XV. Australia
XVI. Central America
XVII. Brazil
XVIII. Peru-Chile
XIX. The Pampas
XX. Patagonia
XXI. Polynesia

Some of these faunal regions represent vaguely certain of the main regions of subsequent animal geographers, and others correspond quite accurately to still recognizable subregions or provinces. In others, the geographic knowledge of this time was evidently inadequate for faunal arrangement on any more critical basis, especially in Africa and the Orient.

It is interesting that Schmarda more clearly expressed the unity of the Old World and the New at the North than did any of his successors to the time of Heilprin's *Holarctic*. Schmarda also faced the fundamental noncorrespondence of the regions to continental outlines in Africa and Australia. His work forms a very satisfactory preliminary to the era immediately following, of Sclater and Günther and Darwin and Wallace. I omit consideration, in this paper, of his marine regions.

In 1858 P. L. Sclater published a review of the distribution of birds and Albert Günther one of the distribution of reptiles. Sclater's subdivisions of the land-masses in accordance with their bird life were so well considered that they formed the basis of the arrangement employed by Wallace, in his major work, and with some modifications are largely still current. His major subdivisions were:

1. Palaearctic: Europe, Northern Africa, Northern and Central Asia.
2. Ethiopian: Africa south of the Atlas Mountains, and Madagascar.
3. Indian: India, Southeastern Asia, and the Malay Archipelago eastward to Celebes.
4. Australian: Australia, with New Guinea and the adjacent islands, New Zealand and Polynesia.
5. Nearctic: North America as far as Mexico.
6. Neotropical: Central and South America, with the West Indies.

Alfred Russel Wallace had lived for many years in tropical regions, first in the Amazon basin and later in the East Indies, where he had been especially impressed by the phenomena of animal distribution. He thus had a broader and more direct and intimate acquaintance with the subject than any other naturalist traveller of his century. He was continually at work on this subject from 1860 until 1876, the date of publication of his two volumes on *The Geographical Distribution of Animals*. He somewhat modestly refers to this work as an extension and amplification of the two chapters on the subject in the *Origin of Species*, comparing it with Darwin's own two-volume expansion of the chapters on animals and plants under domestication. The two principal sections of Wallace's work are contrasted as "zoological geography," a descriptive discussion of the land animals of the different zoogeographic regions, and "geographical zoology," a review of the distribution of vertebrates and certain invertebrates, group by group. Whatever their fate in a reclassification of regions and subregions, Wallace's scheme (Fig. 1) and nomenclature are the ones that appear most widely in zoological literature, and his divisions of the several regions, though less well known, were also in the main well chosen and well defined. His change of the term Indian for Southeastern Asia and the East Indies, to Oriental, has been uniformly followed. His arrangement of regions and subregions was given in Table 1.

TABLE 1

Wallace's Zoogeographic Regions and Subregions

Region	Subregion
Palaearctic	European
	Mediterranean
	Siberian
	Manchurian
Ethiopian	East African
	West African
	South African
	Malagasy
Oriental	Indian
	Ceylonese
	Indo-Chinese
	Indo-Malayan
Australian	Austro-Malayan
	Australian
	Polynesian
	New Zealand
Neotropical	Chilian
	Brazilian
	Mexican
	Antillean
Nearctic	Californian
	Rocky Mountain
	Alleghany
	Canadian

Subsequent to Wallace's major work of 1876, the first important modification was Heilprin's proposal for a reevaluation of the affinity of the North American and Eurasian faunas, emphasizing their close relations by uniting the Nearctic and Palearctic Regions into a Holarctic Region. Wallace preferred the contrary emphasis on the relations of his Neartic Region to the Neotropical. The circumpolar, Northern Hemispheric faunal relations are now seen to be the more significant in the context of Mesozoic origin, and the Tertiary isolation of the northern continents by the Panama Strait and the Tethys Sea. The Holarctic includes not only the existing uniform life of the Arctic tundra and taiga, but much more ancient elements in Europe, eastern Asia, and in western and eastern North America that quite evidently date from the late Cretaceous and early Tertiary. The resemblances between the Chinese fauna and that of eastern North America are extraordinarily paralleled in the two floras (Schmidt, 1943; Li, 1952). The problem of faunal division of the North American continent set by the elements in it from different ages of dispersal was only partly solved by Heilprin, who reserved the great southwestern desert and semi-deserts as a separate Sonoran transition area. This was adopted by Lydekker (1896) as a separate Sonoran Region, inserted between the Holarctic and the Neotropical, and extended to include the southeastern United States.

I have attempted to compromise the divergent emphases by dividing the Holarctic into three subregions instead of two, i.e., into an Arctic, a Nearctic, and a Palearctic. This idea of separating an Arctic Region (or subregion) is not new. It dates obviously from Trouessart (1890).

Discussions of the matter of equivalence of the various regions led Huxley, as early as 1868, to the idea that Sclater had been quite wrong in brigading the Nearctic and Neotropical Regions as "Neogaea" against "Paleogaea" for the four Old World Regions. Huxley, from examination of the more primitive groups of birds, proposed a north-south division into Arctogaea and Notogaea. Shorn, finally, of the whole of North America, Neogaea, the New World, remains as a third main realm best regarded as equivalent to the realms Arctogaea, the North World, and Notogaea, the South World, as was realized by W. T. Blanford in 1890.

After the turn of the century, other interests and other problems came to occupy the attention of systematic zoologists interested in the geographic distribution of the groups of animals with which they were otherwise concerned. When positive data from paleontology had accummulated as to the origins and emigrations of animals, it became evident that animals found in one region had actually come from another, and the meaning and usefulness of the concepts of descriptive animal geography were more and more challenged. If the northern parts of North America and Eurasia be designated as the "Holarctic Region," and if camels arose somewhere in that region, then the cameloid guanaco, vicuña and llama must be reckoned as Holarctic elements in South America, in the sharply distinct "Neotropical Region." There are in fact a host of such Holarctic elements, not only in neotropical South America, but also in the "Australian Region," which in other respects is quite as distinctive as the Neotropical. With the distinction of the great faunal regions

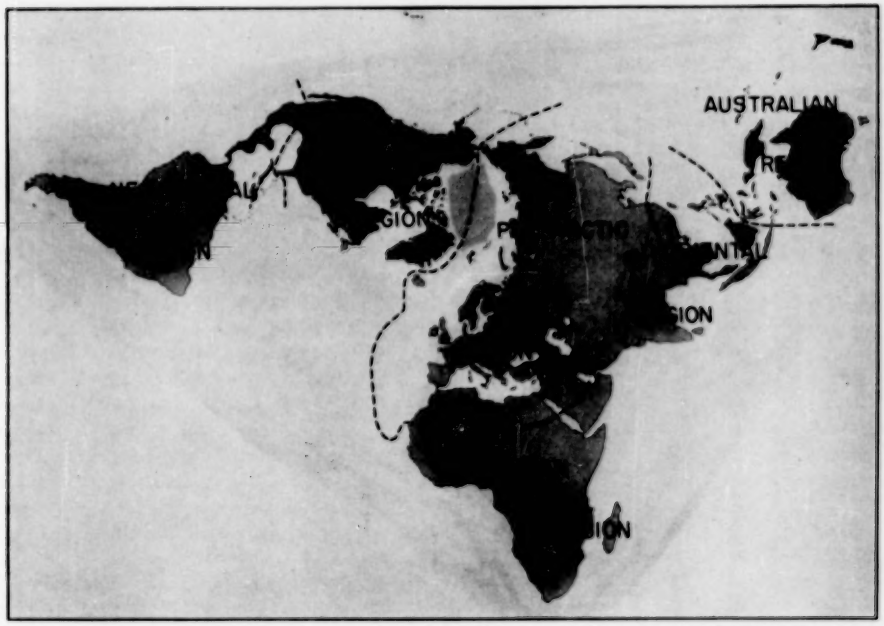

FIG. 1. THE CLASSICAL REGIONAL DIVISION OF SCLATER AND WALLACE.

and their faunas thus so much obscured when the history of their faunal elements is examined, it had been suggested that the whole series of geographic regional terms be given up. Emmett Reid Dunn (1931), Ernst Mayr (1946), and Simpson (1953), specialists respectively in the study of amphibians and reptiles, birds, and fossil mammals, have forcefully stated this position. The idea of a changing and evolving but definable fauna they admit; the faunal regions they regard as mythical. A candid inspection of the controversy between Wallace and Heilprin as to the proper placing of North America as a zoogeographic region brings the whole subject of faunal partition into disrepute. It was the defect of most early efforts at faunal definition and partition that they were based mainly on the distribution of birds and mammals. An attempt to give more adequate consideration to the distribution of the cold-blooded vertebrates, by P. J. Darlington, Jr. (1948), is especially illuminating. This matter also introduces problems beyond the scope of the present essay.

The concept of a south polar "Antarctogaea," limited to the Antarctic continent and the associated islands, seems to be superfluous. It is introduced by Woodbury (1954), evidently for its logical contrast with Arctogaea. The fauna of the Antarctic continent is distinguished only by its breeding colonies of marine birds and mammals, some of which (like the emperor and king penguins) are extremely distinct types. The development of so distinctive a fauna of penguins and seals in the Antarctic is associated with the remarkable richness in life of the antarctic seas, and with their distinction as a marine region. The term Antarctogaea was employed by Sclater (1874), in an entirely different sense, for Notogaea.

STATUS OF ZOOGEOGRAPHIC REALMS

Taking the recent critical views of the zoogeographic regions into full account, I believe that there remains some degree of usefulness in the geographic concepts and in the series of familiar names for the individual areas. It has been implicit in the ideas of faunal areas that they all somehow represent geographic isolation. If the idea of geographic isolation is made explicit and is applied where evident barriers do not now exist, the degree and duration of isolation in the past are the keys to the evolution of a definable fauna inhabiting a definable faunal area. Such isolation introduces the historic factor in faunal geography, and necessitates the careful distinction of the ecological "biotic provinces" (Dice, 1943). These

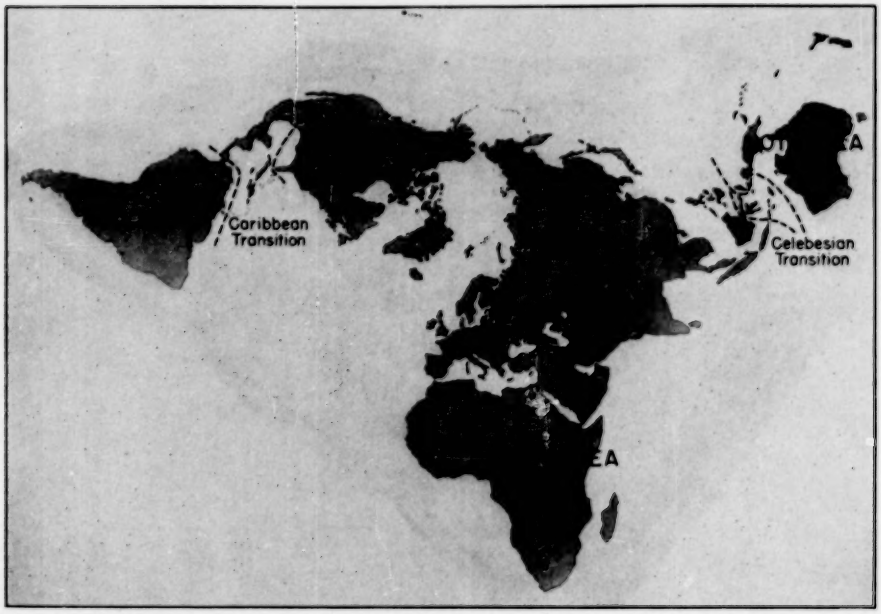

FIG. 2. THE THREE GREAT REALMS AND THE TRANSITION REGIONS BETWEEN THEM. DIAGRAMMATIC.

represent adjustment to *existing* conditions and are commonly visible in the vegetational formations that represent such adjustments, which involve ecologically adapted animal life. Historic isolations, with time for adaptive radiation of a fauna, cut across the ecological distributions. The marsupial fauna of Australia and New Guinea equally dominates desert and grassland and forest.

Incomplete isolation of the major geographic land areas and their reconnection and reseparation; major and minor immigrations and emigrations; different ages of origin of important groups of animals, and different capacities for dispersal (under the broad concept of vagility) have obscured the definitions and boundaries of the regions in question and have made the whole matter almost unbearably complex. It is the nature of biology to be complex, and the function of science to discern the underlying order, however obscured. If we trace our ideas of realms and regions to their geographic isolation and to the duration of the isolation in geologic time, they still do make sense, and retain a degree of usefulness.

In the main, the evidence is conclusive that Australia had been without direct connection with Eurasia throughout the Tertiary and through part of the Mesozoic. It is likewise clear that South America was separated from North America, and from the rest of the world, through the greater part of the Tertiary, and perhaps through part of the later Mesozoic. In both Australia and South America, the existing faunas and what is known of their extinct animals testify to the independent evolution of these faunas over the long period of the Tertiary. Both of these great southern continents are set off from the rest of the world by the remarkable products of independent evolution of their whole faunas. They have been *theaters of evolution*, and it is this that is reflected in the division of the land surfaces of the earth into major realms, Notogaea, Neogaea, and Arctogaea (Fig. 2).

The important zoogeographic controversies over theories of direct land connections between the continents of the southern hemisphere, and over the alternative theories of continental drift with separation of the several continents from an earlier union, are here avoided. Our concern is with Tertiary isolations and connections. I believe the pre-Tertiary faunas of all three southern continents have been derived from the northern landmasses, and have set this forth elsewhere (Schmidt, 1943).

No theory of South Atlantic or trans-Pacific connection of the southern continents in the Tertiary is tenable when the total faunas of the continents are considered, for the problems introduced by such hypotheses are much greater than those they attempt to solve (Millot, 1952).

STATUS OF THE REGIONS AND THEIR SUBDIVISIONS

With the land surfaces of the earth divided into three realms we turn to the somewhat more familiar but less sharply defined division into Regions. Neogaea does not require subdivision, and the corresponding regional name is Neotropica. The problem as to where to place New Zealand, Antarctica, and the Pacific Islands is solved by placing their impoverished but evidently long isolated faunas as an appendage to Notogaea proper. I prefer to combine Wallace's Polynesian and Novozealandian subregions into an Oceanian Region. The special geographic problems posed by such "appended" areas, and especially insular ones, will require further analysis.

The Palearctic, Nearctic, Oriental, and Ethiopian Regions of Wallace's scheme compose the Arctogaean Realm, the third and by far the most active and progressive "theater of evolution." It has been more and more useful to regard the Palearctic and Nearctic as subdivisions of a single region, the circumpolar Holarctic. This view is reenforced by what is now known of the repeated interchange of Eurasian and North American faunas during the Tertiary. The resemblances between Palearctic and Nearctic faunas depend on land connections in the Alaskan-Kamchatkan region; their differences, on the repeated interruption of that connection, and on isolation of the temperate faunas by the development of the extremes of the Arctic climate.

The Old World tropics, from West Africa to the Greater Sunda Islands, divided by Sclater and Wallace into the Ethiopian and Oriental Regions, have so many mammalian and avian groups in common (pangolins, elephants, great apes, hornbills), that I wish to emphasize this fact by combining them into a Paleotropical Region, employing an accepted phytogeographic concept and term. Lydekker's emphasis of the Madagascan fauna as requiring a Malagasy Region is followed here, my subregions of the Paleotropical Region being equivalent to his regions.

The relative *rank* of the various divisions, i.e., region versus subregion or subregion versus province, is a matter of emphasis and opinion, much more than is their definability, and has been as much argued and shuffled as are similar questions of taxonomic status of zoological groups. Wallace divides each of his six regions somewhat arbitrarily into four subregions. In order to retain as much of his terminology as possible, while combining some of his regions, his subregions become provinces in the arrangement here set forth. The provinces in my scheme are major zoogeographic divisions based on considerable periods of isolation, and thus do not correspond to the provinces of ecologists (e.g., Dice, 1943).

I have attempted what seems a reasonably logical but eclectic arrangement in the accompanying table, with thirty-one provinces in place of Wallace's twenty-four subregions. An Arctic and a Caribbean subregion are introduced as major divisions of Holarctica, and other modifications have been mentioned.

The most radical departure from the familiar arrangement is the incorporation of the West Indian and Central American Provinces into a Caribbean Subregion and the placing of this with the Holarctic rather than with the Neotropical Region. This action is based on their geologic history and on some faunal relations that are plainly Tertiary and perhaps not immediately evident. It is foreshadowed in my examination of the reptilian fauna of the "paleopeninsula" of Central America (Schmidt, 1943) and is flatly adopted for the West Indies by Bond in his review of West Indian birds (1936). The Holarctic relation of the West Indies is strongly supported by their mammalian fauna, fossil and recent. Mayr, in his discussion of the origin of the North American bird fauna, points out now partly obscured North American elements in Central America. George S. Myers' important examination of the fresh-water fishes (1938) clearly detaches the West Indian fish fauna from the South American.

The distinction of the Neogaean Realm is based on its long separation from the northern continents at the Tertiary Panama Strait. Central America, during the Tertiary, seems to have been represented by one or more islands, whose geological relations are with North America and the West Indies rather than with South America. Much of the familiar relation of the Central American fauna with the South American is apparent only, as shown by the tapir and the larger carnivores, or is the result of the post-Pliocene invasions from

TABLE 2

Zoogeographic Scheme Here Proposed

Realms	Regions	Subregions	Provinces
Arctogaean	Holarctic	Arctic	Arctic
		Nearctic	Canadian
			Appalachian
			West American
			Sonoran
		Caribbean	Central American
			West Indian
		Palearctic	European
			Siberian
			Manchurian
			Tibetan
			Mediterranean
			Eremian
	Paleotropical	Oriental	Indian
			Ceylonese
			Indo-Chinese
			Malayan
			Celebesian
		Ethiopian	West African
			South African
		Malagasy	Seychellian
			Madagascan
			Mascarene
Neogaean	Neotropical	Neotropical	Amazonian
			East Brazilian
			Chilean
Notogaean	Australian	Australian	Australian
		Papuan	Papuan
	Oceanian	New Zealandian	New Zealandian
		Oceanic	Oceanic
		Antarctic	Antarctic

South America. The distinctness of the Neogaean Realm is as much weakened by listing the Central American types in its fauna as is that of Notogaea by the inclusion of the Celebesian monkeys and insectivores.

Central America, in fact, presents the same kind of transition between two zoogeographic Realms as does the Celebesian area in the East Indies, the mammalian and reptilian faunas in each case being dominated by the Tertiary expansion of the vast Arctogaean fauna. The importance to zoogeographic thought of the examination of transition regions is well shown by the recent renewed discussion of "Wallace's Line" (Scrivenor et al., 1943; Mayr, 1944). The subject of such transitional areas is illuminated by Simpson's discussion (1953) of "filter bridges" and "sweepstakes" routes of dispersal.

The sharp boundaries set by existing or Tertiary water barriers or by so extreme a topographic feature as the Himalayas provide fairly sharp definition of many of the regions and subregions. The

FIG. 3. THE REGIONS AND SUBREGIONS HERE PROPOSED. BOUNDARIES DIAGRAMMATIC.

isolation on which such definition depends dates from the middle or late Tertiary for the several regions and subregions of Arctogaea; and their definition is further complicated when the barriers are climatic and not topographic (though still historic). The Ethiopian subregion is separated from the Palearctic and the Oriental by a chain of deserts that serve as highways for the dispersal of desert-adapted animals, and this has made for faunal interchange between the African and Eurasian continents. The establishment of an Eremian Province of the Palearctic recognizes this as one of the major historical transitional areas. It will be evident that I have supplied a quite inadequate and merely tentative partition of the Ethiopian, Neotropical, Australian, and Papuan subregions.

A different obstacle to the drawing of a faunal boundary is presented in South China, where the transition from the temperate Palearctic to the tropical Oriental Region is by uniform gradation, the result of long-continued progressive intermixture of the Oriental and Palearctic faunas.

A logical rather than a practical difficulty set for the whole matter of the definition of faunal areas lies in the evaluation of negative evidence. This difficulty appears in all of the islands and island groups that have been long separated from the continental sources of their faunas, or whose faunas have been received entirely by overseas dispersal. Thus the West Indies, so evidently Neotropical in their flora and in their invertebrate fauna, are astonishingly deficient in mammals, and in fact in other vertebrates as well. The negative evidence

supplied by the freshwater fish faunas of Madagascar and Australia (and of the West Indies) strongly contraindicates any Tertiary land connection of these regions, and supports the evidence of the independent evolution of their faunas through their long isolation (Myers, 1949). I have ignored this problem in allowing the equivalence of the Seychellian and Mascarene Provinces to that for Madagascar. The justification for naming them as distinct is to call attention to some especially remarkable features of their faunas, which appear to be related specifically to long-continued isolation. Their inclusion with Madagascar as a separate subregion of the Paleotropical (Lydekker, 1896) seems entirely warranted. The negative aspect of the faunas of islands offers an even more acute problem when we turn to an analysis of the faunas of New Zealand, Antarctica, and Polynesia.

It must again be stated that I hold no brief for a static geographic division of the world into zoological realms and regions and provinces. I have presented a list of the classic divisions because I find the terminology useful in attempting to think about the problems of the origin of a given fauna in terms of the diverse origin of various definable elements. In stating the case *against* regional analysis and *for* faunal analysis, Mayr (1943) has employed at least a half dozen of these terms. I have added a slightly modified regional partition because it reflects some of the more recent faunal analysis. In fact, it is precisely the results of faunal analysis that are, at its best, made diagrammatic in the geographic regions.

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POLYSPERMY

By LORD ROTHSCHILD

Department of Zoology, Cambridge University

DEFINITION

AFTER fertilization the haploid egg nucleus normally fuses with a single haploid sperm nucleus: in the rare event of it uniting with more than one sperm nucleus, development is almost invariably abnormal. Two mechanisms exist to prevent polyandrous syngamy of egg and sperm nuclei. One of these, Type I Inhibition, consists in the prevention of all but one spermatozoon from entering the egg. In the second mechanism, Type II Inhibition, several spermatozoa enter the egg but only one sperm nucleus unites with the egg nucleus.

TYPE II INHIBITION OF POLYSPERMY

The eggs of selachians (Rückert, 1899), urodeles (Jordan, 1893), reptiles (Oppel, 1892), Polyzoa (Bryozoa) (Bonnevie, 1907), birds (Blount, 1909), some molluscs (Bretschneider, 1948), and many insects (Richards and Miller, 1937) are normally polyspermic in the sense that several spermatozoa enter the egg at fertilization. Only one of these fuses with the female nucleus, the remainder degenerating near the surface of the egg, though abortive divisions of the supernumerary sperm nuclei sometimes occur. Fankhauser (1925–1948) has made a most interesting study of polyspermy in the eggs of *Triton* (*Triturus*, *Molge*, *Diemyctylus*) *palmatus* and *viridescens*, in which several spermatozoa usually enter the egg after insemination. In spite of polyspermy, cleavage is normal and monospermic provided less than ten spermatozoa enter the egg, although for three hours after fertilization the egg appears to be typically and pathologically polyspermic. At the time when *the* sperm nucleus (the one which happens to be nearest the egg nucleus after maturation) fuses with the egg nucleus, the supernumerary sperm nuclei, which may have proceeded as far as prophase or even to the release of chromosomes (particularly in *T. viridescens*), begin to degenerate, those nearest the fusion nucleus degenerating first. If, after fertilization, an egg is ligatured so that one half contains the egg nucleus and sperm nuclei, the half in question develops normally. The other half, which contains sperm nuclei but no egg nucleus, cleaves as frequently as a normal egg, but the cleavages are usually abnormal and retarded. Nuclear and astral cycles are often out of phase in dividing supernumerary sperm complexes. In a half of a previously fertilized egg which contains the egg nucleus but no sperm nucleus, cleavage is incomplete and anastral, while if a half contains no egg nucleus, cleavage is frequently abortive. When one half has neither egg nor sperm nucleus, there is either no cleavage or abortive cleavage. If a fertilized egg is constricted, *not* ligatured, so that it becomes shaped like a dumb-bell, the situation becomes more complicated, but can be summarized as follows, calling one half of the dumb-bell L and the other R.

L, female nucleus and sperm; R, sperm; thin bridge between L and R. Cleavage in L and R.

L, female nucleus and sperm; R, sperm; thick bridge between L and R. Cleavage in L but not in R.

L, female nucleus; R, sperm. No cleavage in L, cleavage in R. When the bridge is thick, the male or female nucleus sometimes moves across the bridge and joins the other nucleus, in which case a normal first cleavage furrow occurs in L or R.

These experiments suggest among other things that some substances may diffuse out of the female nucleus, or *the* sperm nucleus under the influence of proximity to the female nucleus, which cause degeneration of supernumerary spermatozoa. Some further information about this substance might perhaps be obtained by continuing Fankhauser's studies with different bridge widths between dumb-bells and by observing the variations in the times at which supernumerary sperm nuclei

degenerate according to their distance from the fusion nucleus. These remarks apply particularly to the eggs of *T. palmatus*. In those of *T. viridescens*, supernumerary sperm nuclei which are at different distances from the fusion nucleus begin to degenerate at the same time, a phenomenon which is incompatible with a diffusion mechanism. The experiments of Allen (1954), on the behavior of the egg nucleus after fertilization of sea-urchin eggs sucked into narrow glass capillaries, strongly suggest that some substance diffuses out of the sperm head or sperm pronucleus into the cytoplasm, where it affects the female pro-nucleus. Allen found that the latter elongated or bulged in the direction of the sperm head, which at the time was located at the periphery of the elongated egg. To make distinctions between physical and chemical mechanisms in biological systems, except perhaps in the case of such phenomena as electrotonus, is of questionable value; but for what this distinction is worth, Ziegler (1898), who also did constriction experiments with cotton threads on sea-urchin eggs, found that if he constricted the fertilized egg in such a way that the spermatozoon was in one part, connected by a narrow bridge of cytoplasm to the rest of the egg, which contained the female nucleus, that part of the egg which contained the female nucleus failed to divide though the nucleus showed signs of activity, while the part containing the sperm head did divide. A somewhat similar situation occurs in *Crepidula* eggs, in which only that part of the egg which contains the sperm nucleus divides, the other part being called, rather tautologically, a polar body. Evidently one of the essential features in fertilization is the introduction of a division center into the egg by the spermatozoon, "rather than a diffuse chemical action of the sperm" (Morgan, 1927, p. 512). In recent years little work has been done on the fascinating problems raised by Type II inhibition of polyspermic development. Further experiments on newt eggs, which are easily obtained, would bring their own reward.

FAILURE OF THE INHIBITION

Mosaics

Type I and Type II inhibition may fail or be induced to fail, and an immense amount of work was done on the consequences of such failures in the nineteenth and early twentieth centuries (see, for example, Boveri, 1907). When more than one sperm nucleus engages in syngamy, abnormal cleavages occur, followed by the early death of the pathological embryo. Some cases of dispermic adults are, however, known in insects (Goldschmidt and Katsuki, 1931; Morgan, 1929), and in birds (Hollander, 1949), in which large patches of feathers, colored differently from the rest of the animal, are found on occasions. Interesting accounts of two "mosaic" cocks, as such animals are called, bred from the same sex-linked cross, Light Sussex ♀ x Rhode Island ♂, and of a mosaic daughter of a mosaic cock, will be found in Greenwood and Blyth (1951) and Blyth (1954). These mosaics may sometimes be caused by dispermic fertilization, in which case part of the tissue of the animal has a set of genes derived from one spermatozoon and part from a different set of genes derived from the other spermatozoon. The evidence for the existence of dispermic adult humans, or indeed any mammals, is not conclusive.

POLYSPERMY IN MAMMALS

Except in the case of *Ornithorhynchus*, in which it seems that polyspermy is the rule rather than the exception (Gatenby and Hill, 1924), the incidence of polyspermy in mammalian eggs is low, being of the order of 1–2 per cent under normal mating conditions. They should therefore be classified as Type I eggs, in which only one spermatozoon enters. Austin and Braden (1953) recently published an important paper, which includes a review of earlier work, on polyspermy in rats and rabbits. They found that rat and rabbit eggs go through a critical period, depending on the time after ovulation when they come into contact with spermatozoa, as regards their ability to prevent polyspermy. If mating is delayed so that the eggs remain unusually long in the female reproductive tract before fertilization, the incidence of polyspermy goes up quite sharply, which is reminiscent of the increases in polyspermy observed in aging marine invertebrate eggs. These observations, together with the small numbers of polyspermic eggs normally found, confirm that mammalian eggs belong to the Type I class. Although, for obvious reasons, Austin and Braden were unable to obtain any information about the ultimate fate of polyspermic mammalian eggs, they observed that the supernumerary sperm pronuclei did not induce the formation of separate spindles near the periphery of the egg, but approached the female pronucleus and contributed

to the first cleavage spindle. The spindle, however, was normal and not multipolar. These observations raise a number of questions about the fate of accessory chromosomes, but the answers must await the results of further experiments.

TYPE I INHIBITION OF POLYSPERMY

The Cortical Change

Type I Inhibition, often called the Block to Polyspermy, involves a change in the egg surface, after the fertilizing spermatozoon has become attached, such that further spermatozoa cannot enter the egg. It has been known since the nineteenth century that the fertilizing spermatozoon initiates some alteration in the egg which prevents refertilization, and many workers have observed changes in the morphology of the egg surface immediately after fertilization, such that a point on the surface opposite to where the fertilizing spermatozoon became attached is the last to be affected. The wave of granule breakdown in the eggs of *Arbacia punctulata* at fertilization, observed by Moser (1939), and the similar phenomenon observed by Endo (1952) in Japanese sea urchins, are examples of such morphological changes. Some workers, for example Runnström (1928, p. 395), have reported that when the egg is examined with dark ground illumination, a color change passes over the egg surface in four to six seconds. But they did not realize that unless the egg is fertilized at the equator, relative to the observer who is looking down the microscope, estimations of the time taken for the cortical change to pass completely over the egg have no meaning. The observer, whose eye is directly above the north pole of the egg, sees it in optical section, the periphery of the section being the circumference of an equatorial great circle. When a spermatozoon fertilizes an egg, a cortical change spreads out in all directions over the egg surface, from the point of attachment of the spermatozoon (Fig. 1). If the spermatozoon fertilizes the egg exactly at the north pole, the whole periphery of the optical section of the egg will alter instantaneously, because the cortical change reaches all points on the equatorial great circle simultaneously. This is shown in Fig. 2, where the periphery of the alteration in surface structure is shown as a series of "isochrones" depicting the position of the leading edge of the change at various times after the fertilization reaction has started. If the spermatozoon fertilizes the egg at the equator, the periphery of the optical section changes color at the true rate of propagation. At points intermediate between the north (or south) pole and the equator, the propagation rate, as judged by the time taken for the periphery of the optical section to change color, will seem to be faster than it actually is. The form of the conduction-time curve

FIG. 1. THE CORTICAL CHANGE SPREADING OVER THE EGG SURFACE FOLLOWING FERTILIZATION AT 1.30 O'CLOCK

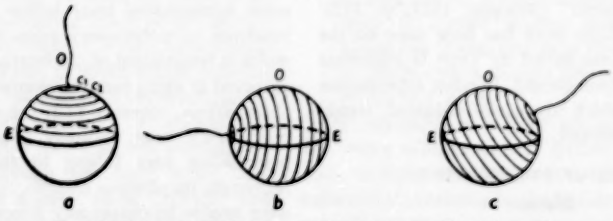

FIG. 2. PASSAGE OF CORTICAL CHANGE OVER EGG SURFACE

The observer at *O* sees the egg in optical section, the periphery of the section being the equatorial great circle *E*. *a*. Fertilization at the north pole. The whole of the cortical great circle *E* changes color instantaneously. *b*. Fertilization at the equator. The cortical great circle *E* changes color at the true rate at which the change is propagated. *c*. Fertilization at 2.0 o'clock. The change affects the cortical great circle *E* more quickly than the whole egg and the conduction rate appears to the observer to be higher than it is. The concentric circles c_1, c_2, etc., represent the leading edge of the propagated change at times t_1, t_2, etc. (Rothschild and Swann, 1949).

will also be affected by these considerations. The best way to make a serious examination of the conduction time of the surface change is by taking dark-ground cinemicrographs of eggs, immediately after insemination, and noting in which eggs an entrance cone can be seen at the equator. When the cone is seen at the equator, the egg was fertilized at the equator. An experiment of this sort shows that the conduction time is about 20 secs. at 18°C in the eggs of *Psammechinus miliaris* (Rothschild and Swann, 1949). It is natural to ask whether the change in surface structure underlying this color change or increase in light scattering is the block to polyspermy, but this at once raises another question—how many spermatozoa collide with the egg and, in particular, with parts of the egg surface unaffected by the surface change until the end of the 20-second period? When eggs are inseminated with fairly dense sperm suspensions, 10^7/ml., swarms of spermatozoa are normally seen round every egg in the suspension; yet only one spermatozoon fertilizes each egg. This has led people to believe that the block to polyspermy passes over the egg in an incredibly short time. But this presupposes that every spermatozoon which collides with an egg is capable of fertilizing it, and this presupposition requires examination.

Sperm-egg collisions and the conduction time of the block

The number Z of spermatozoa, moving in random directions—sea-urchin spermatozoa do move in random directions, even when near homologous eggs (Rothschild and Swann, 1949)—and which will collide with an egg each second is given approximately by the equation

$$Z = \pi a^2 n \bar{c} \qquad (1)$$

where a = radius of the egg, n = no. of sperm/ml., and $\bar{c}$ = mean speed of the spermatozoa. When the appropriate values are substituted in this equation, Z, the number of sperm-egg collisions per second, is found to be 0.16, 1.6, and 16 for sperm densities of 10^5, 10^6, and 10^7 per ml., respectively. These values for Z are probably too high because no account is taken of dead spermatozoa in the suspensions. Although the percentage of dead sperm in mammalian suspensions can be estimated by the live-dead staining technique (Lasley, Easley, and McKenzie, 1942), and is often about 10 per cent, no method is at present available for doing this in suspensions of sea-urchin spermatozoa. As the cortical change takes twenty seconds to pass over the egg surface, there will in that time be respectively 3.2, 32, and 320 collisions at the three sperm densities in question. About half of these will collide with parts of the egg surface already covered by the cortical change, so that at a sperm density of 10^7/ml., only 1/160th of the spermatozoa colliding with the egg surface are capable of fertilizing it, *if* the cortical change is the block to polyspermy. How can the probability, p, of a sperm-egg collision being successful, be estimated? Elementary probability theory shows, and experiments confirm, that if unfertilized eggs and spermatozoa are left in contact with each other for a series of known sperm-egg interaction times t_1, t_2, $\cdots t_n$, secs. ($n \gg 45$), and the number of fertilized and unfertilized eggs are later counted in each case, the proportion of unfertilized eggs, u, is given by the equation

$$\log u = -\alpha t \qquad (2)$$

where α is the sperm-egg interaction rate or fertilization parameter with dimensions $[T]^{-1}$.

Assuming that the spermatozoa do not change their fertilizing capacity during the experimental period, α is a measure of the receptivity of the egg surface to spermatozoa and its value may reflect the fact that, on a submicroscopic scale, an egg surface is probably a mosaic of sperm-receptive and non-receptive regions. It can be expressed, approximately, in the form $\alpha = Zp$, where p is the probability of a successful sperm-egg collision. Some biologists have felt uncomfortable about treating spermatozoa as gas molecules colliding elastically with spheres. In defence of this feeling α, though more abstract, has more "depth" than p and Z. For if we only make the plausible and weak assumption that the chance of an egg being fertilized in a time interval δt is proportional to that interval of time, the proportionality constant being denoted by α, Eq. (2) automatically follows. Another advantage of the α concept over p and Z is that it does not involve such considerations as the random movements of spermatozoa, chemotaxis, and the trap action of egg jelly on spermatozoa. Excluding chemotaxis, these factors interfere, though perhaps not to a great extent, with the "sperm-gas molecule" analogy.

Calculations based on Eq. (2) show that at sperm densities of 7.4×10^4/ml., $p = 0.23$ and at

a density of 9.6×10^6/ml., $p = 0.01$. Further enquiries into the conduction time of the block to polyspermy can be made by means of the following pair of experiments, run at the same time (Rothschild and Swann, 1951). In Exp. 1 unfertilized eggs were mixed with spermatozoa at $t = 0$ and functionally separated after 25 seconds, by killing the spermatozoa but not the eggs. The same procedure was adopted in Exp. 2, but, at the time when the spermatozoa were killed in Exp. 1, more spermatozoa were added, the sperm density being increased by a factor of 100. From the experiment described immediately above Eq. (*2*), it is known what proportion of eggs will have been fertilized in 25 secs. (Exp. 1) at any given sperm density, and therefore what proportion of the eggs will have started their blocks to polyspermy during that time. If, therefore, instead of killing the spermatozoa at $t = 25$, the number of sperm-egg collisions is greatly increased by the addition of more spermatozoa, there should be a negligible incidence of polyspermy unless a considerable number of sperm-egg collisions do occur during the block to polyspermy. Table 1 shows that, in such an experiment, there are three times as many polyspermic eggs in Exp. 2 as there were unfertilized eggs in Exp. 1. In other words, nearly half of the eggs which were fertilized in 25 seconds had not finished propagating their blocks to polyspermy in that time, and became polyspermic because of the new lot of collisions they received after the initial 25 sec. period was terminated. This experiment provides strong evidence for the conduction time of the block to polyspermy being of the order of seconds rather than small fractions of a second, as used to be thought. At the same time there remains the question as to why, if the block to polyspermy takes seconds to pass over the egg surface, so few eggs are normally polyspermic even at comparatively high sperm densities. This difficulty can be resolved by experiments based on the following self-evident proposition. Suppose, for example only, that a number of eggs are all fertilized at $t = 0$ and that the block to polyspermy is complete at $t = 5$ sec. After 5 seconds there will be a certain number of polyspermic eggs in the egg population. The eggs will not all be polyspermic because some of them will not have sustained more than one successful sperm-egg collision during that five seconds. As, however, all the blocks to polyspermy are complete by $t = 5$, the number of polyspermic eggs will never be greater than it is at $t = 5$. If the percentage of polyspermic eggs is 50 after 5 seconds, the percentage will still be 50 after 6, 60, or 600 seconds. It follows from this argument that, if we take a series of egg suspensions and fertilize all the eggs in them at $t = 0$, and then "remove" the spermatozoa (Rothschild and Swann, 1951; Hagström and Hagström, 1954) from these suspensions at various times after $t = 0$, for example at 5, 10, 15, and 40 seconds, the time after which there is no increase in the incidence of polyspermy will be the conduction time of the block to polyspermy. Conversely, any decline in the incidence of polyspermy at $t = r$, as compared with $t = s$, where $r > s$, will be due to sampling errors or mistakes in deciding whether an egg is polyspermic or monospermic. Fig. 3 (Rothschild and Swann, 1952) shows the sort of curve obtained when this experiment is done. In fourteen experiments of this type, the average figure for the conduction time of the block to polyspermy was 63 secs. This type of experiment not only enables one to measure the time taken for the egg to become completely impermeable to spermatozoa after fertilization; it also enables estimates to be made of α during the passage of the 63-second change. During this time, α is only 1/20 of what it is before the first fertilization, which means that the receptivity of the egg surface is twenty times higher before than after the first fertilization. After the 63 seconds, the receptivity of the egg surface is zero. The implications of these observations are shown in Fig. 4, from which it will be seen that the block to polyspermy is probably diphasic, in the sense that a partial block to polyspermy sweeps over the egg surface in a second or so, and is followed by a slower mopping up process which makes the egg completely impermeable to spermatozoa. The cortical change which can be

TABLE 1

Conduction velocity of block to polyspermy (Rothschild and Swann, 1951)

Time sec.	Exp. 1	Exp. 2
0	Sperm added, 3×10^6/ml.	Sperm added, 3×10^6/ml.
25	Sperm killed	More sperm added, 3×10^8/ml.
Unfertilized, %	13	2
Monospermic, %	85	54
Polyspermic, %	2	44

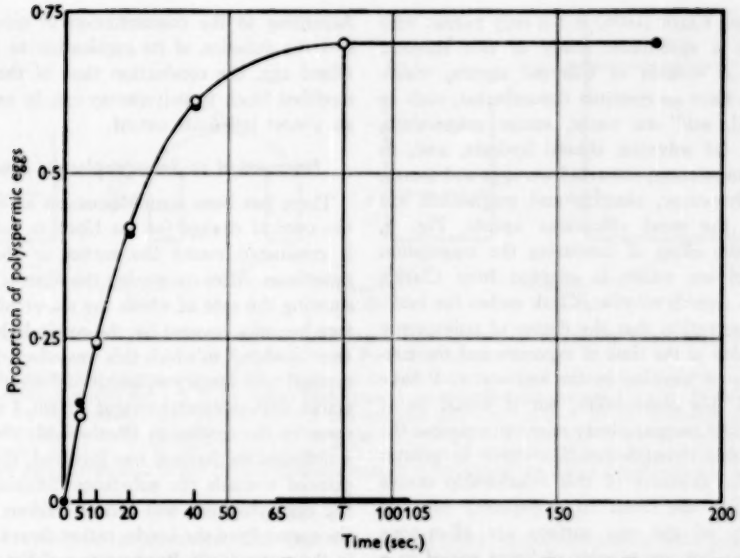

FIG. 3. PROPORTION OF POLYSPERMIC EGGS IN A SUSPENSION AFTER VARIOUS TIMES OF CONTACT BETWEEN EGGS FERTILIZED AT $t = 0$, AND SPERMATOZOA

Sperm density, 9.11×10^5/ml.; ●, experimental points; ○, theoretical points. The time after which there is no increase in the proportion of polyspermic eggs, T, is 85 sec. The thick line from 65–105 sec. on the time axis is the interval within which T lies with a fiducial probability of 0.9 (Rothschild and Swann, 1952).

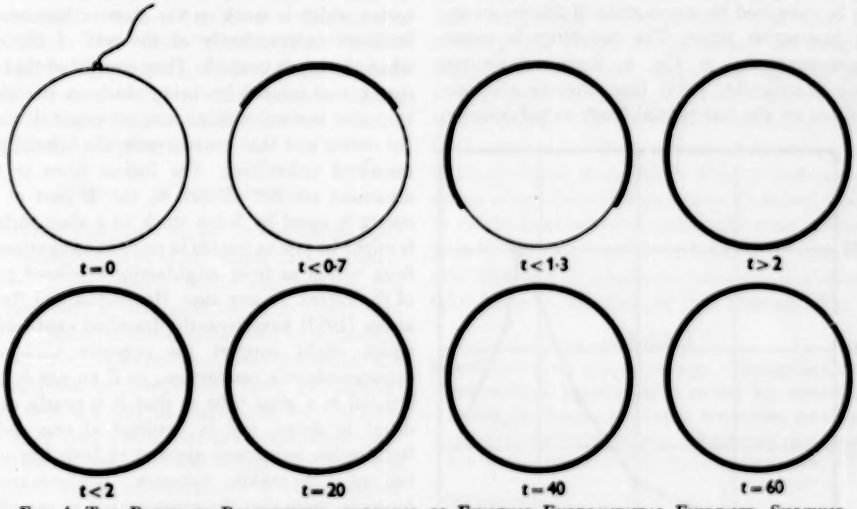

FIG. 4. THE BLOCK TO POLYSPERMY ACCORDING TO EXISTING EXPERIMENTAL EVIDENCE, SHOWING RAPID PARTIAL BLOCK (GREY) AND SLOW COMPLETE BLOCK (BLACK)

t, time in seconds.

seen under the microscope is, therefore, not *the* block to polyspermy, but a reflection or phase of the slow part of it. The recent experiments of Nakano (1954) confirm this analysis.

Induced Polyspermy

The possibility of interfering with the block to polyspermy by chemical treatment of eggs was examined in detail by the Hertwigs in 1887. In

recent years Clark (1936) is the only person who has made a systematic study of this subject. Although a number of different agents, which appear to have no common denominator, such as heat, cold, acid sea water, excess magnesium, alkaloids, fat solvents, chloral hydrate, and, in some circumstances, extracts from eggs and sperm, cause polyspermy, nicotine and magnesium are probably the most efficacious agents. Fig. 5, showing the effect of increasing the magnesium content of sea water, is adapted from Clark's paper. As regards nicotine, Clark makes the interesting observation that the degree of polyspermy is a function of the time of exposure and the concentration of nicotine in the sea water. I have confirmed this observation, but it would be of interest (and comparatively easy) to examine the form of this strength-duration curve in greater detail. The existence of this relationship means that neither the block to polyspermy nor the receptivity of the egg surface are all-or-none phenomena but are capable of being varied in a continuous way over wide limits, quite apart from differences in threshold susceptibility between different egg batches. The question as to which of these two, α or the block, is influenced by nicotine can be examined by the method of known sperm-egg interaction times. The procedure is shown diagrammatically in Fig. 6. Such experiments show (Rothschild, 1953) that nicotine abolishes or slows up the fast partial block to polyspermy.

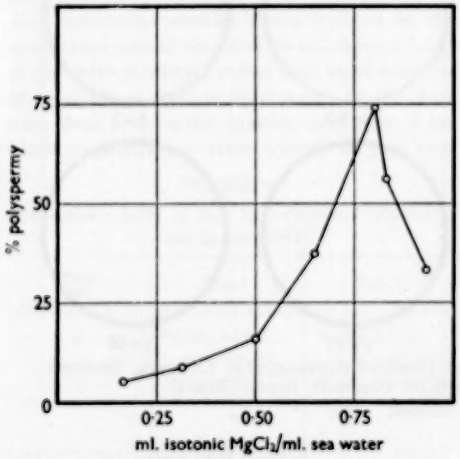

FIG. 5. EFFECT OF MAGNESIUM ON THE INCIDENCE OF POLYSPERMY IN SEA-URCHIN EGGS (After Clark, 1936).

According to the concentration of nicotine used and the duration of its application to the unfertilized egg, the conduction time of the nicotine-modified block to polyspermy can be extended to an almost indefinite extent.

Intracortical vs. intracytoplasmic conduction

There has been some discussion as to whether the cortical change (or the block to polyspermy) is conducted round the cortex or through the cytoplasm. After comparing the form of the curve showing the rate at which the sea-urchin egg surface becomes covered by the cortical change with two "models," in which this was effected by intracortical and intracytoplasmic diffusion of a substance with molecular weight 20,000, I tentatively came to the conclusion (Rothschild, 1949) that if a diffusion mechanism was involved, the evidence pointed towards the substance diffusing through the egg cytoplasm and hitting various points on the cortex from the inside, rather than to diffusion in the cortex itself. Runnström and Kriszat (1952) came to the opposite conclusion on the basis of experiments done with damaged sea-urchin eggs. When these eggs become stuck to a glass surface and are subsequently fertilized, the part of the cortex which is stuck to the glass surface can be fertilized independently of the rest of the egg, when the egg is unstuck. They concluded that the cortex was injured by being stuck to the glass, that the cortical change was propagated round the cortex and that consequently the injured part remained unfertilized. The logical flaws in this argument are not difficult to see. If part of the cortex is upset by being stuck to a glass surface, it might be just as unable to react to some stimulus from within as from neighboring uninjured parts of the cortex. In any case, Hörstadius and Runnström (1953) have recently described experiments which might support the opposite viewpoint, intracytoplasmic conduction; as if an egg is constricted in a glass tube so that it is nearly cylindrical in shape, and is fertilized at one end, a fertilization membrane appears at both free ends but not in the middle. Although it has been known for some years that the cytoplasm of an egg alters in various ways immediately after fertilization, it seems probable that both mechanisms, a self-propagating cortical change as postulated by Allen (1954), and intracytoplasmic diffusion, occur. Whether one, both, or neither are uniquely responsible for the block to polyspermy is a question

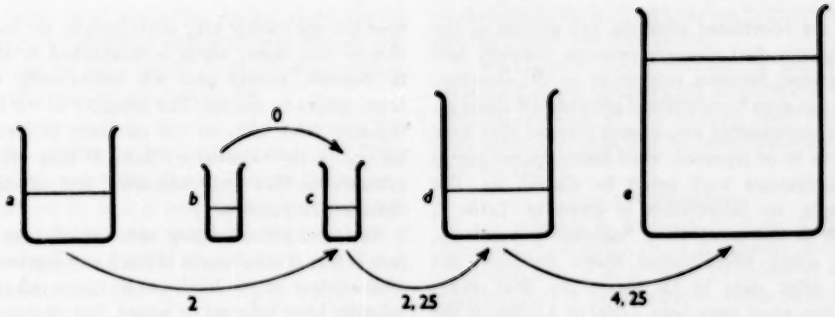

FIG. 6. EXPERIMENTAL PROCEDURE FOR INVESTIGATING THE EFFECT OF NICOTINE TREATMENT OF EGGS ON THE BLOCK TO POLYSPERMY AND α

The curved lines with arrows show which vessels are emptied into which. The numbers by the curved lines refer to the times of emptying, e.g. 2, 25 means that vessel *c* was emptied into vessel *d* 2 min. 25 sec. after the beginning of the experiment, which started when *b* was emptied into *c* at $t = 0$. *a*, 10 ml. of sperm suspension; *b*, 2 ml. nicotine in sea water (1/1000, v/v); *c*, 2 ml. egg suspension; *d*, 90 ml. hypotonic sea water (28%); *e*, 700 ml. sea water + 21 ml. 11% NaCl in sea water. This procedure (Rothschild, 1953) can be simplified to a certain extent by using detergents to kill the spermatozoa instead of hypotonic sea water (Hagström and Hagström, 1954).

which still remains to be answered. The experiments of Amoroso and Parkes (1947) lend support to the view that some substance in the sperm head is concerned with the establishment of the block to polyspermy. They found a higher than normal incidence of polyspermy in the eggs of rabbits inseminated with x-irradiated spermatozoa (>2,500 r). The irradiation may have inactivated some "Block-catalyst" in the sperm head, or modified some substance which normally diffuses out of the sperm head at fertilization and initiates the block to polyspermy.

REVERSAL OF FERTILIZATION

Reference was made earlier to all-or-none reactions. Biologists have often hoped that the reactions of living matter would conform to this principle, but as time goes on, it is found that fewer and fewer do. Fertilization used to be thought of as an irreversible reaction. Once activated, the egg could not be reactivated. Tyler and Schultz (1932) were the first to cast doubts on this concept, when they found that the fertilization reaction could be inhibited and reversed in the eggs of *Urechis caupo* by treatment of the fertilized eggs with acid sea water. Reversal in this species, which is characterized by the egg reassuming its unfertilized appearance in spite of containing a spermatozoon, could only be achieved if the eggs were exposed to acid sea water within three minutes of fertilization. When such eggs are reinseminated, a second spermatozoon penetrates and a normal block to polyspermy is established. More recently Allen (1953), using the egg of the surf-clam, *Spisula* (*Mactra*) *solidissima*, reversed fertilization during the first 4 to 5 minutes after fertilization, by putting the eggs into calcium-free sea water, sea water acidified to pH 5, or sea water containing 0.3–0.5% ether. The most interesting experiments on this subject are those of Sugiyama (1951), using sea-urchin eggs, in particular those of *Strongylocentrotus pulcherrimus*. Refertilization was achieved by subjecting fertilized eggs to calcium- and magnesium-free sea water or molar urea, pH 7, with or without removal of fertilization membranes. Urea was found to be the more effective agent, and some of Sugiyama's results are given in Table 2. If eggs are refertilized before anaphase, polyspermic divisions take place at the time of first cleavage; but if

TABLE 2

Refertilization of sea-urchin eggs (Strongylocentrotus pulcherrimus) inseminated in normal sea water after washing in M-urea for 2 min. Membranes not removed before application of urea. Polyspermic eggs in control inseminations, 0. T°C, 11, (after Sugiyama, 1951)

Time from insemination to immersion in urea solution, sec.	Monospermic Eggs	Polyspermic Eggs
30	2	97
50	4	95
80	4	96
120	93	7

they are refertilized after the full growth of the amphiaster, first cleavage proceeds normally and polyspermy becomes evident at second cleavage. Eggs can even be refertilized after second cleavage. These experiments are of such interest that they deserve to be repeated, when some obscure points in Sugiyama's work could be cleared up. For example, no information is given in Table 2, which is extracted from Sugiyama's paper (p. 341), about refertilization sperm densities; but from other data in his paper, the final sperm dilutions must have been 1/100 or 1/1000. If the semen of this Japanese sea-urchin is similar to that of British varieties, these dilutions correspond to sperm densities of 2×10^8 and 2×10^7 per ml. The first of these is a thick soup, and one wonders what would have happened if untreated fertilized eggs had been reinseminated at this sperm density (cf. Table 1). What, if any, is the effect of supernatants from dense sperm suspensions on fertilized and treated eggs? Doubts may be entertained whether Sugiyama or Rothschild and Swann (1952), in their experiments involving insemination with dense sperm suspensions, have paid sufficient attention to Sampson's work (1922) on the effects of sperm extracts on fertilization and development, though the point is briefly discussed in Rothschild and Swann's paper (p. 479). This question certainly requires further investigation in the context of these recent experiments; but interpretation will be difficult. These difficulties did not arise in the experiments of Hagström and Hagström (1954). They repeated Sugiyama's experiments but used sea-urchin eggs which had been pretreated with trypsin, to remove the vitelline membrane, before fertilization. In these conditions refertilization can be achieved at a comparatively low sperm density, 2.6×10^4/ml.

CONCLUSIONS REGARDING TYPE I INHIBITION OF POLYSPERMY

The experiments described in this review make it possible to construct a tentative and necessarily hazy picture of the operation of the block to polyspermy (Type I). At the moment of attachment of the fertilizing spermatozoon to the egg surface, a change in cortical structure passes over the egg in less, but probably not much less, than two seconds. This reduces the chance of refertilization by a factor of 20, and catalyzes the production of a sperm-impermeable layer at the egg surface. Exploding cortical granules or their equivalent near the egg surface may contribute to the formation of this layer, which is established in about 60 seconds, though this will undoubtedly vary from species to species. The integrity of the layer depends, inter alia, on the existence of divalent cations in the external medium. If they are not present, the layer may "dissolve" and refertilization may be possible.

An action potential may pass over the egg surface before these changes (Péterfi and Rothschild, 1935; Scheer et al., 1954), as so many cell physiologists have believed or hoped, but experiments to establish the existence of such an action potential, or electrical depolarization of the egg surface, are exceedingly difficult, and claims to have observed them must be examined with great care, if not scepticism.

The block to polyspermy and the "fertilization impulse," as the early phases of the fertilization reaction are sometimes called, are being actively investigated at the present time. Partial fertilization, for example, first systematically examined by Allen (1954), will undoubtedly shed light on these phenomena, and in a few years time the picture referred to above will be less hazy, though it may well require some modification.

SUMMARY

1. Two mechanisms exist for the prevention of polyandrous syngamy of egg and sperm nuclei. One of these, Type I Inhibition of Polyspermy, consists in the prevention of all but one spermatozoon from entering the egg. In Type II Inhibition several spermatozoa enter the egg but only one sperm nucleus unites with the egg nucleus.

2. In Type II Inhibition some substance diffuses out of the female nucleus, or the sperm nucleus which is going to unite with the female nucleus, and causes the degeneration of supernumerary spermatozoa.

3. Type I Inhibition, called the Block to Polyspermy, consists in a change in the cortical structure of the egg, the change starting at the point of sperm attachment and passing over the egg surface; this makes the egg impermeable to further spermatozoa. The fastest cortical change so far observed takes about twenty seconds to pass over the egg surface at 18°C. The block to polyspermy is not complete until after the passage of this cortical change, though there is a faster incomplete block which is believed to pass over the egg surface in less, but not much less, than two seconds.

4. There is at present no good evidence for the propagation of action potentials over the egg surface, nor for other forms of electrical depolarization, at fertilization or activation.

5. Agents such as nicotine, which induce polyspermy, abolish or slow up the fast partial block to polyspermy. The degree of polyspermy is a function of the time of exposure and the concentration of nicotine in the sea water. The existence of this strength-duration relationship shows that the conduction time of the block to polyspermy, or the receptivity of the egg surface to spermatozoa, can be varied over wide limits.

6. Fertilization can be reversed by appropriate treatment of the fertilized egg at particular times after fertilization. It has recently been reported that sea-urchin eggs can be refertilized after the first cleavage.

ACKNOWLEDGMENTS

I am indebted to Professor A. Tyler, California Institute of Technology, Dr. G. Fankhauser, Princeton University, and Dr. R. D. Allen, University of Michigan, for advice in the preparation of this review.

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NEW BIOLOGICAL BOOKS

The aim of this department is to give the reader brief indications of the character, the content, and the value of new books in the various fields of Biology. In addition there will occasionally appear one longer critical review of a book of special significance. Authors and publishers of biological books should bear in mind that THE QUARTERLY REVIEW OF BIOLOGY *can notice in this department only such books as come to the office of the editor. The absence of a book, therefore, from the following and subsequent lists only means that we have not received it. All material for notice in this department should be addressed to H. B. Glass, Associate Editor of* THE QUARTERLY REVIEW OF BIOLOGY, *Department of Biology, The Johns Hopkins University, Baltimore 18, Maryland, U. S. A.*

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GENERAL BIOLOGY: PHILOSOPHY AND EDUCATION

MR. TOMPKINS LEARNS THE FACTS OF LIFE. *By George Gamow; illustrated by the author. Cambridge University Press, New York.* $2.75. xii + 88 pp. + 6 pl.; text ill. 1953.

This overoptimistic title is that of the current revival of Gamow's bumbling hero. His adventures during three dreams and a lecture by The Old Professor serve the ostensible purpose of giving the layman a painless acquaintance with biology. Supporting characters include several colleagues under assumed names, possibly to protect the author from deserved retribution. The beginning is auspicious, with Tompkins travelling through his own blood stream accompanied by a physician under the alias of Streets. It begins to look as if facts will emerge when Tompkins observes the structure of haematin but cannot see the structure of the protein to which it is attached. Streets establishes a novel criterion by explaining: "That is simply because you can't see in your dreams the things which have not been cleared up by regular scientific research." At this point Tompkins might have asked how they get the known structures in the first place, and a successful handling of such questions would have made quite a book. The opportunity is muffed, however, and the entropy per page increases through some aspects of physiology now threadbare even in the popular field. The pedagogy is larded with comic-book mishaps, culminating in the intestinal lumen where we meet an individual whose characterization Gamow has seen fit to extend beyond the usual transparent pseudonym. He is dressed in an ornate ringmaster's outfit, carries a long whip, and introduces himself as Herr Max, the famous phage trainer. In the second chapter Tompkins actively hallucinates while reading "a book on cell structure and heredity" which Gamow himself gives little indication of having read. Gamow's genes resemble the dramatis personae of a primitive animistic religion: the function of each is according to its essential nature, e.g., the fingerprint gene determines fingerprints, and so on. Since the experimental and theoretical bases of the gene concept are never mentioned, the whole business takes on a sufficiently low order of credibility to place genetics on the level of a harmless but crackpot metaphysics. The penultimate chapter introduces a computer, the Maniac, and its attending mathematician. Despite an exciting description of the binary number system, Tompkins dozes off as usual. The Maniac describes its abilities, but only the

exceptionally gifted, or those already familiar with such devices, will be able to guess the relations among the binary elements of the machine which permit these operations. In due course Tompkins, appropriately scaled down, gets inside his own brain, where his visit is conducted by Dr. Pavlov himself. There is a memorable incident when Tompkins asks his guide, "Who am *I*? It seems that I have never met *myself* inside my own body!" In the reply, given as a parable, Gamow shows a competence in dealing with philosophical questions which contrasts favorably with his knowledge of biology. In what is, happily, the final chapter, Tompkins unaccountably manages to stay awake during a lecture by The Old Professor on The Nature of Life, in which the remains of vitalism are exhumed and administered a thorough nineteenth-century drubbing.

The scientific content of the book can be most charitably described as apocryphal. Limitations of space preclude an exhaustive enumeration of errors and half-truths, but we learn here, for instance, that bacteriophages are single molecules; that the [sic] antihaemophilia gene produces thromboplastin, prothrombin, and fibrinogen; that the genes governing male characteristics are on the Y chromosome, and that strong radiation doses seem more effective in destroying the cytoplasm than the chromosomes. A great deal of interesting and appropriate material is overlooked entirely; for instance, the problems of ontogeny are not discussed. All this brings to mind the question of the feasibility of attempting a popular account of the scope, methods, history, and present status of a scientific discipline—a challenge which has not been adequately met in biology. Mr. Tompkins' latest misadventures support the usual reciprocal relation between popular appeal and authenticity. Perhaps it is too much to hope that this principle may some day be disproved.

K. C. ATWOOD

THE YOUNGER AMERICAN SCHOLAR: *His Collegiate Origins.*

By Robert H. Knapp and Joseph J. Greenbaum. Published by The University of Chicago Press and The Wesleyan University Press for Wesleyan University, Middletown; [distributed by the *University of Chicago Press, Chicago*]. $3.00. xiii + 122 pp.; ill. 1953.

Young American scientists of promise have somewhat different collegiate origins today than did those scientists now established in their profession. An earlier study by R. H. Knapp and H. B. Goodrich on the origins of American scientists indicated (1) that those institutions producing the most scientists proportionately were of moderate cost, were located in the middle or far West, and drew their students primarily from semi-rural areas; (2) that inferior productivity was demonstrated by institutions of high cost; and (3) that the universities were inferior to the smaller liberal arts colleges.

This latest study covers young scholars of promise in *all* fields of learning. It is based upon the undergraduate collegiate origins of some 7000 individuals who have graduated since 1946 and showed postgraduate academic distinction in the years 1946–1951 by being awarded university fellowships or scholarships, governmental fellowships, private foundation fellowships, or by receiving the Ph.D. degree. The roster of young scholars compiled by Knapp and Greenbaum included individuals graduating from 562 colleges, or about two-thirds of the accredited American colleges and universities.

Concerning the origins of scientists, in contrast to the earlier study the present one indicates that institutions of high cost are now highly productive, and that liberal arts colleges are no longer superior to the universities in this respect. The geographical gradient is also less sharp.

While the various findings of this study will be of significance to the entire field of higher education, the one fact to be pondered by the majority of colleges is the concentration of inspiration and impetus to further scholarship within a relatively small group of institutions. Only about 50 colleges of more than 800 granting baccalaureate degrees reach a rate of male scholar productivity of more than 10 per thousand graduates. The vast majority of the remaining institutions have a rate of less than two per thousand; the dedicated young scholar in these institutions is rare indeed. The productivity of scholars thus rests upon a narrow base in America, leaving undeveloped a large segment of American higher education. Surely there is great promise for those institutions able to supply an adequate intellectual stimulus and to employ effective recruitment. This book deserves careful reading by every college administrator.

FRANK C. ERK

CANCER LEARNING IN THE MEDICAL SCHOOL. *A Report of Four-Year's Investigation of How and What Medical Students Learn About Cancer. Cancer Research Institute, University of California School of Medicine, San Francisco.*

By Howard R. Bierman, Leonard W. Towner, Jr., David W. Galloway, and James N. McClelland. The University of California Press, Berkeley. Free upon request (paper). xii + 87 pp.; ill. 1952.

This book consists of a careful statistical compilation of the results of the intensified education in the field of cancer among medical students during the past decade. The authors attempt to interpret the typical medical student's ability to assimilate cancer knowledge

at various stages during his progression through school. It is hoped that by such an analysis better methods of cancer teaching can be outlined.

ROBERT G. CHAMBERS

BIOLOGIC SCIENCE IN LABORATORY AND FIELD. *Fourth Edition.*

By William C. Beaver. The C. V. Mosby Company, St. Louis. $3.25 (paper). 252 pp.; ill. 1952.

LABORATORY EXERCISES IN GENERAL BIOLOGY. *Fourth Edition.*

By James Watt Mavor. The Macmillan Company, New York. $3.50 (paper). xiv + 333 pp. + 8 pl.; text ill. 1952.

MANUAL OF BIOLOGY. *Part I. The Protozoa and the Plants. Part II. The Metazoan Animals. Revised Edition.*

By Douglas Marsland. Henry Holt & Company, New York. (I) $2.00 (paper); (II) $2.20 (paper). (I) viii + 162 pp.; ill. (II) viii + 207 pp; ill. 1952.

A NEW MANUAL FOR THE BIOLOGY LABORATOR". *Second Edition.*

By Bernal R. Weimer and Earl L. Core. John Wiley & Sons, New York; Chapman & Hall, London. $3.50 (paper). ix + 333 pp.; ill. 1952.

The revisions of these well-established laboratory manuals for the full-year biology course are quite minor. Beaver states: "Certain additions and deletions have been made in order to secure a better balanced presentation. More emphasis has been placed on human biology, higher plants, economic importance, applied biology, and many of the more important general principles. . . . A newer classification of plants is used. . . ." In Mavor's, 5 new plates, nicely drawn by Elmer W. Smith, illustrate the arteries and veins of the frog, and various common forms of plants and animals found in the pond. Marsland says of his: "This revision does not include a very wide variety of new material, but there has been a further critical selection of techniques and methods, whereby the interest and practicality of the exercises has [sic] been enhanced." Weimer and Core have limited themselves principally to rearrangement of their manual. The outline drawings for labeling by the student are now interspersed throughout the text instead of being grouped at the back.

Teachers who have previously used one of these manuals and found it satisfactory will be able to continue to do so. Those who are looking for new ideas in laboratory instruction will not find them here.

BENTLEY GLASS

LABORATORY MANUAL FOR GENERAL BIOLOGY. *Third Edition.*

By Leslie A. Kenoyer and Frank J. Hinds. Harper & Brothers, New York. $2.50 (paper). 180 pp.; ill. 1953.

LABORATORY STUDIES IN BIOLOGY.

By Addison E. Lee and Osmond P. Breland; photographs by Charles Heimsch, drawings by Addison E. Lee and Grace Hewitt. Harper & Brothers, New York. $3.50 (paper). xii + 253 pp.; ill. 1954.

These manuals provide two approaches to laboratory work in general biology. Both manuals have pages punched for a ring binder and perforated, and contain drawings to be labeled by the student. The Kenoyer and Hinds manual uses a traditional approach and is primarily a workbook, asking questions and supplying blanks for the answers; some original student drawings are required.

The Lee and Breland manual uses an expository approach and supplies the drawings for the student. Actual photographs complement the drawings of those objects which are studied under the microscope. The extensive study of vertebrate structure is based on the fetal pig, certainly an excellent form to use in beginning courses, and one which promises to replace the frog and the rat. The drawings are of outstanding quality throughout the manual.

FRANK C. ERK

PLATO. SOCRATIC DIALOGUES, *containing the Euthyphro, the Apology, the Crito, the Phaedo and the Gorgias.*

Translated and edited by W. D. Woodhead; with introduction by G. C. Field. Thomas Nelson & Sons, Edinburgh. 10s. 6d. xxxii + 308 pp. + 1 pl. 1953.

It is not the fashion nowadays for biologists to spend much time in reading philosophy or to admit that there are some elements of life still beyond the reach of an evolutionary, materialistic mold of thought. For such, the *Gorgias*, one of the finest Socratic dialogues, was written. Callicles, a rising young Athenian politician, ambitious and unscrupulous, held himself to be emancipated from current notions of morality, because these were but common superstition. Only what is real and natural, he thought, should govern behavior. The law of Nature is simply that everyone should take what he can without regard to the rights of others—the strongest, the bold, ruthless, clear-sighted superman, should get the most, and is destined to rule by virtue of his superior ability, courage, and determination. This enunciation of what most persons would regard as obviously a Nietzschean philosophy, born out of the evolutionary struggle for existence and survival of the fittest, led Socrates to force his opponent by argument to admit that pleasure is not the same as good, and then to make him stand self-revealed as no realist, but instead simply an idealist who had sub-

stituted his own ideal, his own standards for those of others. How subtly, how subconsciously this may happen we can readily see if we contrast the fascist "evolutionary" views of Sir Arthur Keith with the democratic "evolutionary" views of Ashley Montagu, the one glorifying the evolutionary virtues of war in human history, the other extolling the significance of increasing cooperation—of "love"—among men. Before we turn over the future of human society either to our eugenists or our experts on atomic fission, we might with Socrates make one more effort to secure the real good for the soul of man, to be "more on our guard against doing than suffering wrong, and . . . before all things . . . to study not to seem but to be good . . . to live and die in the pursuit of righteousness and all other virtues." We biologists seem so sure that our science will bring mankind to higher levels of health, wellbeing, and length of days, but are we so sure that it will increase contentment or real happiness? Do biologists themselves, with their insight into the laws of life, experience greater marital happiness or demonstrate better social adjustment than others? Should we not, along with the love of knowledge, nurture the love of wisdom?

BENTLEY GLASS

DIOGENES. *Number 1. A Quarterly Publication of the International Council for Philosophy and Humanistic Studies.*

Edited by Roger Caillois; English translations editor, Elisabeth Mann Borgese. International Council for Philosophy and Humanistic Studies, Paris; [Intercultural Publications, New York]. Subscription, $2.75 (4 numbers); 75 cents (single copy). (1) iv + 145 pp. 1952.

This new journal is to be published in both French and Anglo-American editions. The translation into English and the publication in America are supported by a grant from the Ford Foundation. Occasional contributed papers will directly interest biologists. For example, the first number contains an article by Emile Benveniste on Animal Communication and Human Language: the Language of the Bees, in which the author endeavors to point out the distinctions between human language and the so-called language of the bees. Another article, by Jean Piaget, deals with the relation of Genetic Psychology and Epistemology. The journal also carries a section of book reviews.

BIOLOGY: HISTORY AND BIOGRAPHY

ROGER BACON *in Life and Legend.*

By E. Westacott. Philosophical Library, New York. $3.75. 140 pp. 1953.

One of the appendices of this book is called "Baconiana," and this might have been a fitting title for the whole volume, which consists principally of a series of rather disjointed notes. It is based largely, according to its Foreword, on the biography by Emile Charles, but it draws heavily also on Thorndike's *History of Magic and Experimental Science* and on the eleventh edition of the *Encyclopedia Britannica*, as well as on some random obscurer texts. It is choppy in construction, uneven in content, and is not couched in a form to endear itself to readers accustomed to a more conventional style of specifying the sources of quotations. The price of the book is high for one which leaves virtually so untouched the sum total of human knowledge and appreciation.

JANE OPPENHEIMER

A BRIEF HISTORY OF ENTOMOLOGY *Including Time of Demosthenes and Aristotle to Modern Times with over Five Hundred Portraits.*

By Herbert Osborn. The Spahr & Glenn Company, Columbus. $4.50. iii + 303 pp.; ill. 1952.

Largely a compilation of historical notes, this book is necessarily short on readability. The book contains three parts: Introduction; Regional Entomology; and Personal Sketches Arranged Alphabetically. In the introductory portion there are general accounts of the development of entomology in commerce and industry, of entomological classification, of economic entomology, and of medical entomology. The regional section is little more than an extensive list of the workers in various parts of the earth who have made entomological contributions of significance; and the alphabetical section is like a dictionary of persons, with dates of birth and death and the briefest of notes upon each. An unusual feature of the book is the very extensive collection of portraits of entomologists, arranged 9 to a plate and amounting to 58 plates.

Laborious as the work of compilation must have been, the final product is scarcely definitive, although it may conceivably serve someone else as a rich source in preparing such a work. As a test case, it may be noted that although T. H. Morgan, and Calvin B. Bridges are mentioned, of the real contributors to modern *Drosophila* systematics (A. H. Sturtevant, J. T. Patterson, et al.) only Th. Dobzhansky is listed. And what can one say of the omission from the list of the greatest living insect anatomist, R. E. Snodgrass, of the most notable insect physiologist, V. B. Wigglesworth, and of the most eminent living student of insect behavior, Karl von Frisch?—though, to be sure, two of these men are briefly mentioned in other places although omitted from the list.

BENTLEY GLASS

COTTON MATHER. *First Significant Figure in American Medicine.*

By Otho T. Beall, Jr. and Richard H. Shryock. The Johns Hopkins Press, Baltimore. $4.00. x + 242 pp. 1954.

This discussion of the medical interests and achievements of Cotton Mather has been reprinted from Volume 63 of the *Proceedings of the American Antiquarian Society*, and represents Volume V in the First Series of Monographs published by the Institute of the History of Medicine. Roughly the first half of the book is a competent description of Mather's medical backgrounds, attitudes, and contributions, together with a history and analysis of Mather's most extensive medically oriented opus, the unpublished "The Angel of Bethesda." The remainder of the volume presents the *Proposals* for printing the "Angel," which list the titles of 66 chapters, and selected sections from 12 of these.

The main substance of the discussion by the present authors and also of the excerpts chosen for publication deals with rather general problems: the fusion of medicine and theology in Mather's thought as related to his theories of the causes of illness; his "animalcular" hypothesis of the nature of disease; his contribution to the progress of preventive medicine by his earnest advocation of inoculation as protection against smallpox. From the point of view of these broad theoretical or social questions, the authors, although they freely acknowledge his lack of particular influence except in regard to inoculation, establish Mather as "the first significant figure in American medicine." If he is to be admitted to this position of eminence, it is to be hoped that eventually his biological and medical writings, circumlocutionary and repetitive though they may be, will be published in full, especially since writings of the American Colonial period are so scarce. The fact, however, that the present volume serves to whet the taste for more is itself the best possible evidence of its merit as a successful exposition of its theme.

JANE OPPENHEIMER

WILLIAM CHESELDEN, 1688–1752.

By Zachary Cope. E. & S. Livingstone, Edinburgh and London; [The Williams & Wilkins Company, Baltimore]. $4.50. viii + 112 pp. + 15 pl. 1954.

William Cheselden, an anatomist and surgeon of distinction who set the precedent for the better-known Hunters in more ways than one, receives his due in this excellent biography which grew out of Sir Zachary Cope's Vicary Lecture. Cheselden was a talented individual who made his reputation in surgery principally by his improvement of procedures in lithotomy and ophthalmology. His influence, however, reached far into medical education, not only through his contributions as an anatomical lecturer and author—his *Anatomy of the Humane Body* was a highly popular manual throughout the greater part of the eighteenth century—but also through his considerable support to the successful movement to divide the Company of Barber-Surgeons into its two separate components. The biography is eminently sound, well documented, well constructed, and well written. It contains "new" material, and the author has a perceptive eye for what is interesting both in the way of illustrations and of quotations. Surely Cheselden's account, quoted in full, which records the sensations of a youth, blind since birth, who gained his sight as a result of Cheselden's ministrations, is one of the more illuminating documents ever to flow from the pen of man. In short, the book as a whole is admirable, and is warmly recommended to those who appreciate either the art of surgery or the art of good biography.

JANE OPPENHEIMER

NOBEL PRIZE WINNERS IN MEDICINE AND PHYSIOLOGY, 1901–1950.

By Lloyd G. Stevenson. Henry Schuman, New York. $6.50. x + 292 pp. + 15 pl. 1953.

This volume, along with its two counterparts by other authors covering physics and chemistry respectively, constitutes a set entitled *Pathfinders in 20th Century Science*, and it represents Volume 29 in *The Life of Science Library*. It includes, for each Laureate, a brief, strictly professional biography, only in the rarest instances more than a page in length, a short description "in his own words" of the work for which he received the award, and a short evaluation by the author of its significance.

The portions of the book that should hold the greatest interest are unfortunately the least successful, namely, the statements "in their own words," of which a number must seem unintelligible to the general reader, and many of which for both lay and professional reader have sacrificed all semblance of fluency to the necessity for frequent interruption by ellipses and by square bracketed editorial comment. The writing in both the interpolations in the text and in the discussions of the work's consequences seems a bit uneven. In the section concerning the field of my own competence, the names of one distinguished embryologist and of one distinguished embryo are misspelled, and these are not the only evidences in the book that the author has devoted to it somewhat less in the way of meticulous attention to detail than one has come to expect of him.

The roster of Nobel prize winners who achieved their awards during the first half of this century includes many great investigators who have made contributions of prime importance, and it is a pity that the volume

was not planned to include, in addition to appraisals of the separate accomplishments, a more general section assessing their total significance. Their influence as compared to that of the achievements of other wise scientists who have failed to receive the prize; the degree of their pragmatic content; their relationships to progress in other fields of science or other areas of thought and action;—the data included in the book represent highly favorable material for the discussion of these and many other historical and philosophical aspects of developing medicine. Until that time when they are treated from a more comprehensive point of view, the present volume will remain a convenient handbook of reference.

JANE OPPENHEIMER

HISTORY OF AMERICAN PSYCHOLOGY.

By A. A. Roback. Library Publishers, New York. $6.00. xiv + 426 pp. + 27 pl. + folding chart. 1952.

This comprehensive compilation of material covers the development of psychology in America (mainly the United States, with some cursory remarks about Canada) during the past 300 years. One quarter of the book is devoted to the period preceding William James. This is especially significant, inasmuch as so many people, even psychologists, consider American psychology to have begun with the publication of James' *Principles of Psychology* in 1890.

The book contains a wealth of material and references. The most recent period is also enriched with material gained through the author's personal contacts with many important figures in psychology. About two dozen portraits scattered throughout the book help to liven it up considerably. An admirable quality of the book results from the author's forthrightness in assuming and defending a point of view. To be sure, he occasionally gets quite verbose in presenting his own ideas, but this is preferable to the more frequently encountered dodging of issues on the ground of so-called objectivity. Despite these good qualities the book suffers from several shortcomings. The style of writing is uneven and at times becomes quite cumbersome. Sentences of 80 to 100 words are not infrequent; and this results in the need for rereading for proper comprehension.

Another issue might be raised about the organization of the material, which is divided into three parts. Part I covers the period prior to James. Part II is devoted to a discussion of several important figures in psychology, viz., James, Hall, James McKeen Cattell, Baldwin, Titchener, and Münsterberg. Part III covers the schools of psychology, beginning with functionalism and ending with neo-scholasticism. Here it is often necessary to duplicate material already covered in Part II; and yet, naturally, the discussion of the contributions of others not mentioned earlier is also required. The net result is rather confusing. Just what prompted the author to adopt such a form of organization is not obvious.

One more point should be raised. As the many developments are unfolded showing the progress of psychology from the level where it was concerned with the possibility of more than one soul occupying one body to the more current issues raised by logical positivism, one looks in vain for a motif that connects these events —a motif that the author had promised the reader early in the volume. Instead, we are presented with an array of events, be it the publication of an important work, the development of a particular school, or the perfection of a new technique, as though each event had no connection in time or substance with any other event in psychology. To be sure, there are occasional exceptions to this, but one does not get the feeling from the book that psychology grew because it had burning issues to face and to solve.

These weaknesses notwithstanding, there is much to be gained from reading and studying this book; and it is, therefore, recommended to all who are interested in the history of psychology.

SONIA F. OSLER

A HISTORY OF PSYCHOLOGY IN AUTOBIOGRAPHY. *Volume IV.*

Edited by Edwin G. Boring, Herbert S. Langfeld, Heinz Werner, and Robert M. Yerkes; Contributions by Walter Van Dyke Bingham, Edwin Garrigues Boring, Cyril Burt, Richard M. Elliott, Agostino Gemelli, Arnold Gesell, Clark L. Hull, Walter S. Hunter, David Katz, Albert Michotte, Jean Piaget, Henri Piéron, Godfrey Thomson, L. L. Thurstone, and Edward Chace Tolman. Clark University Press, Worcester. $7.50. xiv + 356 pp. 1952.

This is the most recent in a series of volumes begun in 1930, and interrupted for many years by the war. The design was to produce a history of psychology through the medium of the autobiographies of those men who have made outstanding contributions to this discipline. Volume IV contains the story of the lives of 15 men who were born between 1878 and 1896. Of these 15 psychologists, listed in the title, 8 are American and 7 are European. It is apparent that all the men chosen have in one way or another had an important influence on the development of psychology as a science. Despite the fact that there appears to have been some effort by the editors to assure the type of biography most suited to the purpose, the individual assignments were carried out in a variety of ways. Some of the men went back into familial histories for several generations, some did

not even mention their fathers' occupations, and one began with his university days.

Before attempting to evaluate these various efforts it may be appropriate to ask the following question: What values are inherent in this method of writing the history of psychology that are superior to those that might accrue fron a traditional type of history? A few of these come immediately to mind: a first-hand view of the history of important original ideas, a statement of controversial views "from-the-source" without the biasing effect of a historian, a glimpse at the motivations underlying choice of field and particular lines of interest within psychology (and this is especially interesting since a significant proportion of these 15 psychologists changed into psychology from engineering, mathematics, or the physical sciences), and those personal interactions so difficult to specify which, nevertheless, often have noteworthy consequences.

To accomplish this each biographer should, among other things, submit a lucid, though necessarily short, discussion of his ideas and scientific contributions. In this regard, however, there is the greatest variation of treatment. Some men have provided merely a chronological inventory of academic diplomas, jobs, and publications; others, like Gemelli, enter into profound discussions of the theoretical implications of their work; still others, like Boring, touch upon these matters so cursorily as merely to whet one's appetite to hear more. Consider, for example, the following remark from the biography of the latter: "Why I became a monist and a physicalist reacting against Titchener's dualism is not entirely clear. Dualism seemed unsatisfactory to me, to represent a discontinuous causal relation, action at a distance. And physicalism seemed to me to solve the meaning problem as mentalism could not." One is tempted at this point to ask "how", but in vain, for the printed page remains silent. It is of some interest that the Europeans, much more than the Americans, emphasize discussions of ideas.

Despite the shortcomings of some of the treatments, the book represents a contribution of real value to psychologists, and particularly to non-psychologists, who may, above all, acquire by reading the book a familiarity with the scope and meaning of psychology. This is especially valuable because there is so much haziness on this point, and so many people tend to believe that psychologists spend their time either treating the mentally ill or running rats through mazes.

SONIA F. OSLER

TWENTY-FIVE YEARS OF SEX RESEARCH. *History of the National Research Council Committee for Research in Problems of Sex 1922–1947.*

By Sophie D. Aberle and George W. Corner. W. B. Saunders Company, Philadelphia and London. $4.00 (paper). v + 248 pp. 1953.

This small book is a history of the Committee for Research in Problems of Sex of the National Research Council during its first 25 years, 1922–1947. In addition, it contains a bibliography of all investigations supported by this Committee through June, 1952. The history of this particular group records not only the usual problems of such committees in distributing the available funds to applicant investigators, but details the concern of the committee with the traditional attitudes and taboos surrounding the subject. The formation of the Committee under the sponsorship of the National Research Council, with all its immense prestige, aided in a very special way in encouraging competent men to lend their talents to this important field. The history enumerates the difficult decisions facing the Committee (and faced by all such committees) as to whether it should devote its efforts to fundamental research or to applied and operational studies. How this problem was resolved may be noted by a perusal of the list of grants, which ran the gamut from the albino rat to Kinsey.

This small history is not only interesting to those who are especially concerned with research in the problems of sex, but should also be of particular interest to any committee charged with the problem of the distribution of funds in any specific field. The book is well done and nearly unique, in that few other historical accounts in this domain are available.

HOWARD W. JONES, JR.

THE YOUNG NATURALIST

GEORGE CANSDALE'S ZOO BOOK.

By George Cansdale. Phoenix House, London; [British Book Center, New York]. $2.00. 64 pp. + 39 pl. 1954.

It seems a shame to find fault with this genial book and its friendly author. If there is a fault, it is that it is too miscellaneous—a mixture of exciting peeps behind the scenes at the zoo, with a good deal that any visitor to the zoo can see for himself.

It is a matter of wonder, for instance, to read that the sea-water for the London Zoo's aquarium comes from the Bay of Biscay; that monkeys will pick weevils out of spoiled food (a major source of the zoo's provisions) with the same relish shown by a child picking raisins out of cake; and that tiger and leopard cubs are often reared by canine foster-mothers. Apart from such esoteric details as the last, however, the fascination of animal babies lies in seeing them rather than in hearing about them, and the photographs in this section are more interesting than much of the text.

George Cansdale has been responsible for television programs from and about the London Zoo. Besides a chapter on this subject, there are other special features contributed by the Curator of the Aquarium, the Zoo

Artist, and a keeper. A chapter on the classification of mammals seems really to belong to another book, a review of the animal kingdom, which maybe Cansdale will write for zoo visitors, young and old. The book is well illustrated with photographs.

EILEEN S. GERSH

STRANGEST CREATURES ON EARTH.

Edited by Edward M. Weyer, Jr. Sheridan House, New York. $4.00. 255 pp. + 32 pl.; text ill. 1953.

Not every editor has a second chance. Once he has accepted a piece and it is printed in his magazine, the chips fall for better or for worse and the dust of oblivion conceals the good with the bad. Not so with *Natural History* Magazine and *its* editor. For E. M. Weyer has culled from the back volumes an amazing selection which merits in every way its dedication to Fleetwood Stoltz "who can tell the truth so it sounds like a lie." Over three dozen accounts tell of the oddest animals: diving spiders, parasol ants, fish that shoot their prey, or walk, or climb, or have four eyes. Well-chosen illustrations help the uninitiated to meet each of these strange creatures. The short chapters themselves are models of clear, scientifically accurate reporting in layman's language. Editor Weyer, fresh back from ethnological exploration of his own in the untravelled Matto Grosso of Brazil's hinterland, can be exceedingly proud of his selections.

LORUS J. & MARGERY J. MILNE

PROJECT MOUSE. *Rx Mouse and X Mouse.*

Edited by Clarence C. Little; with drawings by Francis J. Rigney. The New Hampshire Chapter of the Jackson Laboratory Association, Deering. $1.00 (paper). xiv + 83 pp.; ill. 1952.

While designed primarily to explain and interest the high school student in the use of the mouse in research work at Jackson Memorial Laboratory, this attractive, well-illustrated booklet provides a mine of information about the collecting, laboratory care, and dissection of the mouse, as well as the natural history of some common mice and shrews of North America.

FRANK C. ERK

ECOLOGY AND NATURAL HISTORY

THE WEB OF LIFE. *A First Book of Ecology.*

By John H. Storer. The Devin-Adair Company, New York. $3.00. 144 pp. + 44 pl.; 1953.

"This book is written for everyone interested in the wise use of our soil and water, our forests and wildlife, and for everyone who would learn what has largely been forgotten in our machine age—how all living things fit together into a single pattern." With a central portfolio of excellent photographs, fully captioned into an independent but parallel picture story, John Storer summarizes clearly and with simplified case histories the building of soil, of forests, and of grasslands, traces their succession through the seasons and the decades, and shows how a local calamity on a mountain top can ruin a fisherman along a seacoast hundreds of miles away. Forest fires and careless lumbering, overgrazing and senseless elimination of insect-eating and rodent-eating predators, improper plowing, abuse of streams and rivers by loading them with sewage and industrial wastes—these are Man's addition to the picture. The volume ends with the question: Can Man use his intellect to control his own destructiveness before he destroys himself through ruining his sources of water and food?

LORUS J. & MARGERY J. MILNE

JOURNEY INTO WONDER.

By N. J. Berrill. Dodd, Mead & Company, New York. $4.00. xiv + 338 pp.; ill. 1952.

Recipe: take one well-trained modern biologist, the logbooks and diaries of early exploration, an artist's pen and typewriter; blend quotations from the classic accounts with contemporary retelling of the tale; spice with scientific conclusions as to the plants and animals the real adventurers described in their non-technical style; bind between cloth covers. Serves for many an evening's pleasant, light reading. Christopher Columbus, John Hawkins and Richard Hawkins, ex-buccaneer William Dampier, George Forster and Captain James Cook, Alexander von Humboldt, Charles Darwin, and explorers of polar lands take their places in the first 22 chapters. The final two chapters round out the picture by delving into the fossil records of the Americas, bringing the whole clock of time into sharper scale through recent techniques of dating from radioactivity.

LORUS J. & MARGERY J. MILNE

HAMMOND'S GUIDE TO NATURE HOBBIES.

By E. L. Jordan; drawings by Herbert Pierce. C. S. Hammond & Company, Maplewood and New York. $2.95. 64 pp.; ill. 1953.

In this sequel to his *Hammond's Nature Atlas of America*, Jordan has outlined, with an average of an illustration per page, the fundamental features of nature hobbies requiring a minimum of equipment: collecting rocks and minerals, shells, herbarium specimens, insects, and photographs; attracting and observing birds; maintaining a terrarium and an aquar-

ium; and has included a page and a half on fishing and hunting. Recommendations are given for books and pamphlets useful to the beginner, and some for the more advanced amateur.

LORUS J. & MARGERY J. MILNE

TROPICAL AQUARIUMS, PLANTS AND FISHES.
By A. Laurence Wells. Frederick Warne & Company, London and New York. $2.50. 230 pp. + 12 pl.; text ill. 1954.

The keeping of small, brightly colored fishes in the home aquarium increases in popularity every year all over the world. To meet the growing demand for information about the hobby, a steady series of books, pamphlets, and elaborate commercial catalogues has been published recently in England and America. The claims of this British book described on its jacket are modest. It says, "In this book the author describes how to set up, heat and maintain an aquarium, listing suitable plants with which to stock it and giving useful advice on the feeding, tending and breeding of tropical fishes." In addition, Wells gives "individual descriptions of the appearance and habits of 127 species and the text is further supplemented with 75 text drawings and twelve plates in full colour showing 56 fishes."

There is little that distinguishes this book from others that are available except perhaps in a negative way, for some of the information is slanted towards the British aquarist. According to the copyright, this book was originally published in 1937 and it might be expected therefore that this edition would be bright with new information. There are few signs that this is so. A spot check of the section devoted to fishes that give birth to living young indicates that these fishes are still listed under the family Cyprinotontidae. That was wrong even in 1937. Some books are bought for their fine illustrations. The ones in this book may be gaudy but they are inaccurate. A novice seeking information concerning this hobby might do better to write to some of the larger dealers for their illustrated catalogues, which can be purchased for one-tenth the cost of this book. The biologist seeking information concerning the basic principles of keeping and breeding fishes must be patient. His book has not yet been written.

MYRON GORDON

NATURE PARADE.
By Frank W. Lane. Sheridan House, New York. $5.00. 334 pp. + 32 pl. 1954.

This is an American edition, with additions, deletions, and afterthoughts, of an earlier British book. As such, it reflects not only the better than 1,000 books and 5,000 magazines, monographs, abstracts, newspapers, and specialist journals that were consulted, but also suggestions and criticisms of reviewers, correspondents, and other readers. Gleaned from these many sources are facts, all supposedly accurate, which almost tumble over one another, so rapidly are they presented. Most of them deal with animals under natural conditions, and the sources of the information are given in many instances.

Two, almost equally large, sections are followed by a small third. The first, entitled Private Lives, cites example after example, chiefly from among vertebrate animals, of the seemingly normal activities that can be classified under food (means of capture and capacity), grooming, sleep, leadership, strength, war, and self-care (under the title "doctoring"). Measurements are introduced to support the discussion of food capacity and strength. They become even more numerous in the second large section, on Speed and Locomotion, and culminate in a Jumping Table for mammals, and in speed tables for mammals, birds, fish, and insects. A further discussion and speed tabulation concern Trespassers—mammals in air (bats) or under water (hippopotamus), birds running on land or swimming under water (penguins), flying fish, and the like.

In the final small section, space is given to the evidence for Mysteries such as the Abominable Snowman of the Himalayas, a large tiger-cat of North Queensland, and the Nandi bear of Kenya. The evidence seems to have been sifted carefully, with a strictly "let's wait and see" attitude, though one expecting an interesting denouement when the remaining facts are known. A good index permits easy reference to the host of information presented.

LORUS J. & MARGERY J. MILNE

LIFE HISTORIES OF NORTH AMERICAN WOOD WARBLERS. *Order Passeriformes. U. S. natl. Mus. Bull. 203. By Arthur Cleveland Bent. Smithsonian Institution, Washington.* $4.50 (paper). xi + 734 pp. + 83 pl. 1953.

This is Number 19 in the well-known series of life histories of North American birds, by A. C. Bent. The present volume includes the New World family of wood warblers, the Parulidae. About 57 species of these occur in North America. The treatment of the individual species and their geographic races is essentially the same as in previous volumes. Complete life histories have been contributed by W. M. Tyler, A. O. Gross, E. von S. Dingle, A. Sprunt, Jr., and J. Van Tyne. Bird students who are not familiar with these publications should become acquainted with them and should try to obtain as many of the series as possible, since they are useful sources of information.

HENRI C. SEIBERT

AMERICAN BIRD SONGS. *Volume Two. Authentic recordings of 51 bird voices, captured with a microphone in the birds' natural habitats.*

Recorded by P. P. Kellogg and A. A. Allen for The Albert R. Brand Bird Song Foundation. Cornell University Records, a division of Cornell University Press, Ithaca. $7.75. 12-inch 33⅓ RPM record. 1954.

SONGBIRDS OF AMERICA *in Color, Sound and Story.*

By Arthur A. Allen and Peter P. Kellogg; foreword by Roger Tory Peterson. Cornell University Press, Ithaca. $4.95. 10-inch 33⅓ RPM record; 28 pp.; ill. 1954.

The first of these two records is a remake on a 12-inch LP of an earlier 78 RPM album which has already been enthusiastically received by a wide audience. Side 1 carries the songs of 10 familiar birds of shade trees and gardens, 10 birds of the roadside, and 5 birds of lakes and marshes. Side 2 continues with 14 more birds of lakes and marshes, and ends with 12 North American warblers. Reproduction—excellent.

The second item is an innovation in bird records, for the 24 recorded birdsongs on a 10-inch LP are housed in a plastic-bound album that contains A. A. Allen's beautiful color photographs of these 24 birds, previously published in the *National Geographic Magazine*, and a text comprising a general account of bird habits, migration, songs, and colors, bird photography and recording and how to attract birds, together with an individual account of the geographical distribution, size, habits and song (transliterated) of each of the birds represented. These, only 3 of which are included on the first record, are as follows: bluebird, brown thrasher, chickadee, Carolina wren, red-eyed vireo, warbling vireo, yellow warbler, robin, goldfinch, catbird, red-winged blackbird, rose-breasted grosbeak, bobolink, mockingbird, meadowlark, indigo bunting, Baltimore oriole, wood thrush, house wren, song sparrow, fox sparrow, white-throated sparrow, pewee, and cardinal. The proper scientific names of the species and varieties have unaccountably been omitted.

This remarkably fine effort to combine sound, color, and descriptive information is somewhat marred by the sentimentalized introductions given by the announcer. The succinct, matter-of-fact identifications on the larger record are much less likely to cloy with repetition.

BENTLEY GLASS

WAYS OF MAMMALS *in Fact and Fancy.*

By Clifford B. Moore. The Ronald Press Company, New York. $3.50. xii + 274 pp. 1953.

Those who know are frequently both annoyed and exasperated by the gullibility of people in believing such hoary yarns as that bears suck their paws to sustain themselves in winter, that wolverines forcibly accelerate their gluttony by squeezing themselves between two saplings, or that the male opossum copulates with the female through her nose. This little book deals with these and many other ancient myths, exposing them for what they are, and in many cases disclosing their origin. By contrast many other facts, some just as incredible, are amply justified by firsthand evidence.

In the closing pages of the book the author has done what many of us have wished to do: come to grips with many popular misconceptions concerning mammals in general, among them the relationships between monkeys, apes and men, the anthropomorphic imputation of human characteristics to animal behavior, and the belief in the wildest of impossible hybrid combinations. Finally, there is a philosophical comment on that peculiarly American phenomenon, the tall tale, and its place in relation to mendacious folklore. This is a fascinating little book, one that you will want to read more than once.

BRYAN P. GLASS

BETWEEN PACIFIC TIDES. *An account of the habits and habitats of some five hundred of the common, conspicuous seashore invertebrates of the Pacific Coast between Sitka, Alaska, and northern Mexico. Third Edition.*

By Edward F. Ricketts and Jack Calvin; revised by Joel W. Hedgpeth. Stanford University Press, Stanford. $6.00. xiii + 502 pp. + 1 pl.; text ill. 1952.

With minor additions, the text of the new edition (2nd ed., *Q.R.B.*, 24: 48. 1949) remains unaltered; but Joel Hedgpeth has expended a great deal of time and effort in correcting minor mistakes and in bringing up to date the extensive appendix, which is in the form of an Annotated Systematic Index and Bibliography. The important papers through 1951 are now listed, and the nomenclature has been straightened out. Some new illustrations have also been added. Yet in the main this is still the remarkable product of Ed Ricketts, whose unorthodox and incomplete education in biology led Professor W. C. Allee, his teacher, to label him as "Ishmaelite," one of those students "who tended sometimes to be disturbing, but were always stimulating." The book is clearly a labor of love, first by Ricketts himself and thereafter by Calvin, his literary collaborator and photographer, and by Hedgpeth, who have together improved the original without in any way destroying its unique, stimulating quality. Among books on the seashore, this one, although limited to invertebrate life, takes high rank.

BENTLEY GLASS

LA VIE ÉTRANGE DES RIVAGES MARINS.

By Edouard le Danois. Horizons de France, Paris. 2,950 fr. 192 pp.; ill. 1953.

The French have long been among the most devoted students of the seashore, in particular of the shores of Brittany and of the Mediterranean, and this book is a popular culmination of that study. Inspired in part by Yonge's finely illustrated book, this one is an even more lavish presentation of the printer's art. The color printing of the photographs is of that superb quality attempted in this country only in expensive advertisements of pharmaceutical houses, and the page size (8¾ by 11¼ inches) shows the printing off to finest advantage. The five aquarelles by the author, however, make a somewhat bizarre contrast to the splendidly reproduced color photographs. The text offers a summary of the geological history and setting of the French coasts, of the zonation of animals on rocky shores, of the various muddy, sandy, and estuarine bottom facies and of the types of life associated with various types of marine vegetation. The treatment is primarily descriptive—often eloquently so—and for those who plan to visit a French marine station, this will be an excellent introduction to that environment.

JOEL W. HEDGPETH

FAUNA I BIOLOGICHESKAYA PRODUKTIVNOST' MORYA. *Vol. 1. Mirovoi Okean. Vol. 2. Morya SSSR.*

By L. A. Zenkevich. Sovyetskaya Nauka, Leningrad. (1) 506 pp.; 259 figs. (2) 588 pp.; 327 figs. (1) 1951; (2) 1947.

MORYA SSSR IKH FAUNA I FLORA.

By L. A. Zenkevich. "Uchpedgiz," Moskva. 368 pp.; 258 figs. 1951.

These books by Zenkevich deserve to be well known to all marine biologists. The first, *Fauna and Biological Productivity of the Seas*, is a fully documented 2-volume survey of marine biology, especially the fisheries aspects, with many examples drawn from European and American literature. Volume Two of this work, devoted to the seas of Russia (including the Baltic, the Sea of Japan, and part of the Bering Sea), offers a summary of work in Russia, especially since the Revolution, that is not obtainable anywhere else. Indeed, no Western library seems to have complete sets of the various Soviet journals devoted to fisheries biology and the work of various marine stations. This volume in particular deserves translation. It is interesting to note, in this connection, the surprising number of translations of books in English available to Russian students, including the works of Harvey on sea water, Russell and Yonge, and Johnstone's *Conditions of Life in the Sea*. The high quality of this work indicates that Soviet marine biologists owe no apology to their western colleagues. Indeed, we should reproach ourselves for not having produced a similar summary of our own literature. The second work, *The Seas of USSR, their Fauna and Flora*, known as the "small Zenkevich," is a textbook summary of the 2-volume work, without the bibliographies and acknowledgments of the sources of many of the illustrations. For this reason it is somewhat less useful to students outside the USSR, but it is an attractively printed volume. Since the page size of all these volumes is the long octavo (about 13 by 23 cm occupied by type), and is rather closely printed, they are actually larger books than the mere number of pages suggests.

JOEL W. HEDGPETH

THE NEW ZEALAND-AMERICAN FIORDLAND EXPEDITION. *Preliminary Reports of Investigations in Fiordland, New Zealand, in 1949. New Zealand Dept. sci. indust. Res., Bull. 103.*

Compiled by A. L. Poole. R. E. Owen, Government Printer, Wellington, N. Z. 7s. 6d (paper). 99 pp. + 1 folded map.; ill. 1951.

Interest in the adaptive ecology as well as the big game potentiality of the American Wapiti in New Zealand, engendered on the part of Col. J. K. Howard (U.S.A.) during World War II, led to the organization in 1949 of the New Zealand-American Fiordland Expedition, of which this volume is a preliminary report. The American personnel included J. K. Howard, Olaus J. Murie, and D. Murie, all of whose participation was made possible by a Fulbright award. Many departments of the New Zealand governments, including those of Internal Affairs, Scientific and Industrial Research, Forest Service, Lands and Survey, and Marine, provided personnel and equipment to make this a thoroughly organized and staffed operation. The site of the expedition was in the Fiordland National Park, north and west of Lake Te Anau (where *Notornis* was recently rediscovered), mainly in and about the Stillwater River basin and in the George Sound drainage, South Island.

The first third of the book deals with the preliminary report on deer. Both *Cervus daphus* and *Cervus canadensis* have been stocked on South Island. The former is more thrifty and is multiplying rapidly. Wapiti are not adapting as well, and their numbers are not pyramiding. There is some evidence of hybridization between the two. The most important food plants have been determined, and in areas of great concentration, suitable reproduction of desirable food plants is prevented. Chapters on climate, geology, vegetation, small mam-

mals, invertebrates, fisheries, birds, archeology, and tourist potentialities follow the section on the deer.

Ecologists will be particularly interested in the description of the establishment of forest on a bare rock substratum in the glaciated valleys, and in the rapid transition from rain forest to timberline in less than 3000 feet. Of additional interest are the comments on apparent climatic change and its effect on aging forests in the upper valleys. Ornithologists will appreciate the list of birds, although it is not always made clear which are native and which are introduced.

I found the book most interesting as a vignette of an area in which exotic introductions have created a masterpiece of ecological folly. The area studied is one where the impact of the white man's introductions has not yet been fully felt. Consequently it retains considerably more of the primitive aspect of New Zealand than the agricultural and pastoral parts of the island.

BRYAN P. GLASS

ESQUEMA ECOLOGICO DE SELVA, SABANA Y CORDILLERA EN BOLIVIA. *Pub. No. 3.*
By Guillermo Mann F. Instituto de Geografia, Facultad de Filosofia, Universitad de Chile, Santiago. Paper. 236 pp. + 70 p.; text ill. 1951.

EVOLUTION

L'ÉVOLUTION BIOLOGIQUE. *Les Faits, les Incertitudes. By Lucien Cuénot, with the collaboration of Andrée Tétry. Masson & Cie., Paris.* 2500 fr. (paper). x + 592 pp; ill. 1951.

The late dean of French genetics had almost completed this definitive work of his career at the time of his death. It was a monumental task, the character of which is very well expressed by the book's subtitle. Book One, The Facts, covers 534 pages; Book Two, The Uncertainties, only 36. Yet the key to the author's thinking is assuredly in those 36 pages rather than in all that preceded them. Book One begins with the character of life and its origin on the earth, and sketches historical evolution in broad strokes. A chapter on evolutionary principles or "laws" is followed by an analysis of the relation of evolution to the distinction between germplasm and soma and the dependence of evolution on germinal continuity. Next comes a lengthy and very full treatment of classical genetics, leading into a consideration of mutation, gene action, cytoplasmic heredity, and especially phenogenetics. Chapter 4 deals with adaptation, the struggle for existence, fecundity, predation, and other aspects of natural selection; and Chapter 5 deals with processes of speciation, especially the roles of geographic and genetic isolation, polyploidy, and polymorphism; and thereafter, more briefly, with the distinction between micro-(petite) and macro-(grand) evolution. In all these extensive discussions and numerous examples, the latter of which greatly multiply those cited by other recent writers on the subject, Cuénot adopts with scarcely a hint of doubt the commonly accepted neo-Darwinian, or better named *synthetic*, theory of evolutionary process.

In his brief Book Two, however, Cuénot gives full scope to his lack of conviction. Can one in fact harmonize the extraordinarily complex nuclear and chromosomal structure of the protozoa, and in particular of the parasitic gregarines, with the view that unicellular organisms were the primitive group from which the more complex higher plants and animals of today took origin? Is not the limitation of the mutation of particular genes to a relatively few directions a basis for orthogenetic trends, and is the neo-Darwinist view not too mechanical, too dependent upon chance, and too arbitrary in excluding the possible significance of final causes? How can one explain the presence of protective form and especially of protective color among fishes, who lack predators of those groups, the birds and primates, that are the sole possessors of color vision? Can one completely dismiss the possibility that acquired characters may in some cases become hereditary after a long time, in particular such characters as the callosities that develop in the very young or even before birth, in such animals as ostriches and rheas, dromedaries, and various wild pigs and peccaries? Is there any real difference between lamarckianism and the view that by "stabilizing selection" a character that is at first acquired can be later substituted by a mutation that brings about the same effect? Is Nature at bottom not teleological rather than statistical?

Cuénot leaves these questions unanswered. That he has raised them at all, at the end of so exhaustive a consideration of modern evolutionary knowledge, is the phenomenon that gives one pause. Why did he not explore these questions more deeply, and consider the arguments, if not answers, that have been given to so many of them? Is it not well known that the biochemical complexity of a unicellular organism may, at least in respect of many syntheses, greatly exceed that of the "highest" animals, and that the enzymatic machinery of protoplasm is astonishingly alike throughout all organisms? Is it not obvious that the limits upon mutation raise the question how those intraspecific limits can be transcended in evolution rather than give comfort to orthogenetic theory? Is it not clear that the inheritance of callosities or other adaptive structures that appear before being used are no different than eyes or ears or teeth or every other organ that must develop before it is used? No doubt the capacity of the skin to thicken at points of abrasion was a generally useful quality that existed before any animals acquired hereditary callosities, just as it now exists in many

species that lack them. But more important is the fact, which Carter has pointed out in his book on *Animal Evolution*, that "the stages of the life-history cannot be considered separately in discussions of their evolution." That which is subject to the action of natural selection and which is transmitted from one generation to the next is the entire genome, and it governs the course of the entire life-history. In the last analysis, Cuenot's difficulty is really equivalent to a doubt that any particular gene can be subject to selection, since in all cases the presence of the gene in the fertilized egg must precede the development of any character whatsoever. Finally, it is very certain that there is a real distinction between lamarckian inheritance of an acquired character and the substitution of a mutation with a corresponding effect; for example, the capacity of the human skin to tan is not dependent upon the same genes as the permanent pigmentation seen in Negroes, for the two exist together in the same person, even though the latter tend to mask the action of the former. In these and other respects, it would seem that Cuénot above all needed the sage advice of W. K. Brooks, to wit, that "the mental vice to which we are most prone is our tendency to believe that lack of evidence for an opinion is a reason for believing something else." Like those persons of the past century who would not believe in evolution because paleontologists had found no missing links, Cuénot seems to have let his will to believe in final causes and his inability to explain all evolutionary problems at the present time upset his judgment—and thus in 36 final pages to negate the sound reasoning and laborious accumulation of knowledge of an entire lifetime.

BENTLEY GLASS

PRINCIPLES OF ORGANIC EVOLUTION.

By Arthur Ward Lindsey. The C. V. Mosby Company, St. Louis. $5.75. 375 pp.; ill. 1952.

Just as 1900 was outstanding for the number of scientists who independently discovered Mendel and presented the basis of genetics, so 1952 may be memorable for the sudden appearance of several excellent books on evolution—after a considerable lapse of publishing interest in this direction. Lindsey first brought out a *Textbook of Evolution and Genetics* in 1929, when "the controversy aroused by William Jennings Bryan was still alive in the minds of most teaching biologists." The need for bringing the subject up to date, and offering it in a form useful to college students led to the present volume. It differs from some others in the greater consideration given to the plant kingdom. It is evolutionary biology, not zoology, though a majority of examples are drawn from the animals.

In the presentation of such a tremendous range of subject matter—from biochemistry to biogeography and the fossil record, an author must be extraordinarily selective and consequently is sure to leave out many parts of the evolution story that reviewers cherish. Thus it seems odd that with as much of the historical approach, the Galapagos Islands receive so little attention and Darwin's finches go unmentioned; also that only vertebrate hormones receive mention when so much has been added on the close similarities among invertebrate hormones and among plant hormones, allowing much interchangeability there. Pollination of flowers by insects and the mutual evolution of both receive a sentence and no inclusion in the index. But much of the classical account is included and will be valuable for rounding out the background of students too young to have heard of the Scopes' monkey trial—even from their grandparents.

LORUS J. & MARGERY J. MILNE

There is little to recommend this textbook in comparison with the new ones recently written by Dodson and by Moody. The approach to the subject remains that of 1929, when the present book first appeared under the title *Textbook of Evolution and Genetics*. The new title would seem to imply that major attention is given to the *principles* of evolution; but in fact 263 pages may be said to deal with classical aspects of the subject, with the relationship of organisms, evidences of evolution, the evolution of existing forms, and with adaptation as product rather than process. The scant remainder (101 pages) deals with the modern understanding of the processes of evolution. Even this is not up to date. The author devotes a full chapter to a discussion of Lamarckianism, in which his evident sympathies become clear. The selection of material is definitely one-sided. On the other hand, the tremendous development of evolutionary thought and knowledge since the publication of Dobzhansky's Genetics and the Origin of Species is given little space and clearly shows the author's unfamiliarity with most of it. The significant work of Mayr, Simpson, Rensch, Schmalhausen, Stebbins, J. Clausen, and others too numerous to mention is slighted entirely or casually alluded to. Even for a neo-Lamarckian to expose his students to such a presentation represents a gross injustice.

BENTLEY GLASS

EARTH SONG. *A Prologue to History.*

By Charles L. Camp. University of California Press, Berkeley and Los Angeles. $5.00. vi + 127 pp.; ill. 1952.

This beautifully illustrated and vividly written popular introduction to paleontology should attract many young readers to become students. The style occasionally over-strives to be dramatic, and this contrasts rather strikingly with the quite abundant inclusion of technical names, for the author has made no conces-

sions in this respect. Nevertheless, the general effect is extremely pleasing, and the maps, delicate line drawings, and graphic pencil sketches of the life of the past easily hold their own with, if they do not excel, those by the late noted artist Charles R. Knight.

If this imaginative approach, so kindly allied to respect for factual accuracy, were more broadly and generally applied to the teaching of the sciences in secondary schools, what an immense kindling of appreciation and enthusiasm would surely result. The next step, in this particular field, should be to progress to G. G. Simpson's *Life of the Past*, which illuminates the nature of causal factors and process even as this book illuminates the actual record of the rocks.

BENTLEY GLASS

LIFE OF THE PAST. *An Introduction to Paleontology. By George Gaylord Simpson. Yale University Press, New Haven; Geoffrey Cumberlege, Oxford University Press, London.* $4.00. xii + 198 pp.; ill. 1953.

Few if any biologists have within the past decade been more prolific than G. G. Simpson. As books have issued in a steady flow from his pen, volumes ranging in content from the most searching and fundamental examinations of modern evolutionary theory to the most appealing popular presentations of those subjects upon which Simpson is a recognized authority, one's wonder and admiration steadily mount. In the present book, written for the intelligent beginner, Simpson once again displays that clarity of expression, that perfect adaptation of style to the level of his intended audience, which have previously characterized his writing. Perhaps the most outstanding feature of this book, however, is the perfect subordination of the treatment of facts to the elucidation and exposition of principles. So often, in books that deal with evolution, the reader is so deluged with information that he is unable to see his whereabouts, like a man in a cloudburst who has little cognizance of the larger meteorological phenomena. This never happens in *Life of the Past*. From the Prelude (A Walk through Time) to the end, which brings us to the relation of Fossils to Mankind, the reader moves through a well-charted country, as the chapter headings indicate. These, besides the above-mentioned, are as follows: The Remains of Ancient Life, Fossils and Rocks, Fossils as Living Things, Ancient Communities, Fossils and Geography, The Diversity of Life, Life and Time, Ways of Organic Change, and Theories of Evolution. An appendix adds a Review of the Forms of Life for reference by the real novice; and the book is completed by a list of Suggestions for Further Reading, with terse, significant comments on each; and an Index.

For all biologists who have not had the time to study with care the significant contributions to the modern synthetic theory of evolution made by Simpson in *Tempo and Mode in Evolution* (1944) or the revision of the latter, retitled *The Major Features of Evolution* (1953), this book can be heartily recommended as a summary and digest of the author's ideas. Opinions will differ, and each book has its unique merit, but for my own part I think *Life of the Past* a better-rounded and more valuable book than the widely praised, best-selling series of lectures, on *The Meaning of Evolution*, which Simpson gave us in 1949.

BENTLEY GLASS

CAMBRIAN STRATIGRAPHY AND PALEONTOLOGY NEAR CABORCA, NORTHWESTERN SONORA, MEXICO. *Charles D. and Mary Vaux Walcott Research Fund. Smithson. misc. Coll., Vol. 119, No. 1. (Publ. 4085).*

By G. Arthur Cooper, A. R. V. Arellano, J. Harlan Johnson, Vladimir J. Okulitch, Alexander Stoyanow, and Christina Lochman. Smithsonian Institution, Washington. $3.00 (paper). vi + 184 pp. + 1 folded chart + 31 pl.; text ill. 1952.

Progress in the knowledge of the earliest forms of life which have left a record in the rocks depends not only on finding well-preserved fossils, but also on discovering thick, undisturbed sequences of fossiliferous beds, so that the order of time in which the faunas lived can be unequivocally ascertained. For the early part of the Cambrian period the second condition is more seldom met than the first. For this reason, paleontologists will particularly welcome the report of Cooper and coworkers on the Lower and Middle Cambrian stratigraphy and faunas of Sonora. Cambrian beds in this area were first discovered in 1941. They immediately proved of such exceptional interest that an intensive investigation was undertaken by the United States National Museum in collaboration with the Mexican geologists. The material was assembled and prepared in Washington, and the various groups of fossils were studied by specialists. After a stratigraphic introduction by Cooper and Arellano, Johnson describes the algae; Okulitch, the Pleospongia, a puzzling, long-extinct group of Porifera; Cooper, the Brachiopoda; Lochman, the trilobites and some problematic organisms; and Stoyanow reports on the first finding of fossils in the region. Each article is a competently written and well-illustrated account of the corresponding group. In my own opinion, the greatest value of this contribution lies in the discovery of a thick, orderly, fossiliferous series of Lower Cambrian beds and the description of their faunas. Lower Cambrian sections are well known in the Cordilleran province of the United States and Canada, but fossils generally occur only at a few, widely separated levels. In the Appalachian province the structure is too complicated to allow the study of an unbroken sequence of strata. Hence the section in

Sonora probably affords the most informative stratigraphic-paleontologic succession now known in North America for the early Cambrian period. The Middle Cambrian series also yielded good sections and fossils. However, this is not an exceptional occurrence, since analogous examples are known from the western United States and Canada.

F. RASETTI

DIE BÄNDERSCHNECKEN. *Eine Studie zur Evolution der Tiere.*

By F. A. Schilder and Maria Schilder. Gustav Fischer Verlag, Jena. DM. 20.00 (paper). ii + 92 pp.; ill. 1953.

Two very distinct parts compose this volume devoted to the snails of the genus *Cepaea* (Mollusca, Pulmonata). The first part—of about 20 pages—is a résumé of our knowledge regarding the 4 species of the genus (anatomical characters, conchyliological characters, geographic distribution) and regarding their variability, both quantitative (size, form, etc.) and qualitative (color, pattern of bands, color of the peristome, etc.). This part includes a very complete bibliography, which at the same time indicates the principal object of each cited work. The second part sets forth the results of personal researches bearing on several hundred natural populations of *Cepaea nemoralis* and *C. hortensis* on the isle of Hiddensee (Germany). This is the first time that data have been published at once so numerous and so diverse in respect to these two species, with precise indications regarding the biotopes and respective situations of the colonies. The authors have been specially concerned to describe the relations between the two species, notably their relative density and their relations with the biotope. It seems that man plays a dominant role in the dispersion of *Cepaea*.

For *C. hortensis* as for *C. nemoralis*, F. A. and M. Schilder next give a description of the variability within the various populations of Hiddensee. That of the quantitative characters, which is based on a considerable number of measurements, exhibits a weak influence of the milieu on size: *C. nemoralis* is larger in humid biotopes than in sunny environments. A certain correlation exists between the sizes of individuals of the two species in the colonies where they live side by side.

In the study of the variability of qualitative characters, and notably in respect to the band system, the very individual notations used by the authors render the reading quite difficult and correspond poorly, on the other hand, to the genetic determination. But the very complete tables which are given constitute an important source of data which it would be interesting to analyze further. In fact, the authors have not attempted to utilize their results fully so as to bring out their bearing on modern theories of population genetics.

Very numerous maps and graphs illustrate the work and facilitate the reader's comprehension.

MAXIME LAMOTTE

ANNUAL CYCLE, ENVIRONMENT AND EVOLUTION IN THE HAWAIIAN HONEYCREEPERS (AVES: DREPANIIDAE).

By Paul H. Baldwin. University of California Press, Berkeley and Los Angeles. $1.50 (paper). iv + pp. 285–398; ill. 1953.

This comprehensive work draws upon behavior, comparative physiology and ecology, and population statistics to illuminate the problem of speciation in the Hawaiian Honeycreepers, brightly-colored tropical birds which have long captivated students of evolution as classic examples of endemism and adaptive radiation. The author's purpose is to advance the understanding of evolution in the Drepaniidae, through intensive study of 3 sympatric species. Following twelve years' intermittent study, Baldwin undertook a year's intensive work at 12 stations, most within Hawaii National Park, on a 20-mile transect from 2300 to 7500 feet in altitude. The stations varied as to slope, means of annual rainfall and temperature, type of forest and of local avifauna.

Much of the factual detail has been reviewed elsewhere (see *Wilson Bull.*, June, 1954, and *Auk*, April, 1954). What interests me most personally is the high intraspecific variability in the timing of gonad recrudescence, nesting and molt, and the fact that a cycle of fat accumulation parallels testis recrudescence in these tropical non-migratory species. I wish Baldwin had pursued further the idea of a possible dynamic connection between frontal storms, which cause loss of nests, and the long breeding periods. Since the timing of these storms varies greatly annually, those populations with the capacity to breed over long periods each year would have an advantage over those with more narrowly restricted nesting periods. Long breeding periods could therefore be thought of, not as evidence of the reduced selection pressures of an "easy" environment, but rather as indices of the positive, continuing action of natural selection in a country where capricious storms constitute a limiting factor for nesting.

The author is to be congratulated on the soundness of his approach and the competence with which he presents the wealth of field data. He scrupulously avoids over-simplification. This is especially true in his analysis of molt, of the niches occupied by the 3 species, and of the flowering periods of plants furnishing nectareous food. If at times the data seem bewilderingly complex, the reader must realize that much of that complexity is imposed by the conditions under which the work was done. In fact, I commend this book to all biologists with first-hand knowledge only of the simpler environments of arctic and tem-

perate latitudes. How infinitely more subtle are ecological relationships in a tropical forest!

BARBARA BLANCHARD OAKESON

EVOLUTION AND HUMAN DESTINY.

By Fred Kohler. Philosophical Library, New York. $2.75. iv + 120 pp. 1952.

To establish the interrelationships of the original data obtained in the various areas of science and to integrate them into a consistent, meaningful body of knowledge are as essential to man's overall intellectual progress as the gathering of facts. In this book Kohler aims "to synthesize certain presently known, but heretofore uncorrelated facts, phenomena and relationships into a self-consistent unifying structure." His field is the evolution of matter, from the pre-organic level to modern human society, and while most of his interpretations are not original, his conclusions are interesting and merit some attention.

The evolutionary pattern of the solar system as a whole exhibits an increase in total entropy. Kohler is concerned about those portions of the system where entropy has been decreasing; he applies the term "extropy"—similar to Schroedinger's "negentropy"—to those decreases in randomness which accompany centers of increasing complexity. He sees a pattern in the increasing extropy demonstrated (presumably sequentially in time) by crystals, colloids, proteins, viruses, unicellular organisms, cell-colonies, and multicellular organisms. Each level illustrates a degree of integration of increasingly complex components into a new entity. He terms this tendency "complexification," and conceives it as possibly a basic law of nature.

When multicellular organisms associate with one another and gradually become interdependent within a colony (such as do ants, bees, and termites), a new entity, the "societal organism," develops. While there is evidently no "awareness" by the individual of his role in the functioning colony, he nevertheless has little chance of surviving outside this societal organization. The author takes pains to show how human colony formation fits into the general plan, and how it is becoming ever more closely integrated into a societal organism.

According to Kohler's view, man's intelligence, control over environment, and political history have been essentially functions of the social organism, rather than of the biological pattern of the individual. Many of our "human" characteristics fall into this category as well, since human beings raised without contact with other humans result in individuals differing little from the higher animals, and possessing few "human" traits. The growing integration of the human colony was expedited by the development of language and, eventually, writing and printing; these made possible the formation of a "societal memory"—the sum total of society's collected experiences. Because of this, science and technology were possible, thus freeing more and more men from the tasks of providing food and shelter. Just as in other colony formations, the survival of an individual is becoming more and more dependent upon his existence within the human colony. The remarkable human possession of consciousness, whereby matter becomes aware of its own existence, is interpreted as being a function of the developing societal organism, and of improbable occurrence within the mind of an isolated individual.

The evolving human societal organism is in the early stages of integration, and although its ultimate design can be approximated only, the extrapolation of Kohler's concept implies an organismic reproductive system, such as is observed in the cell-colony and all higher forms. Just as a specialized component of the organism preserves the species, so a specialized group will produce the next generation of the human societal organism. For the proponent of extreme positive eugenic measures, these predictions should be pleasantly reassuring.

FRANK C. ERK

DER GEISTIGE AUFSTIEG DER MENSCHHEIT *vom Ursprung bis zur Gegenwart. Second Edition.*

By Prof. Dr. Hans Weinert. Ferdinand Enke, Stuttgart. DM. 19.—(paper); DM. 21.60 (cloth). viii + 303 pp.; ill. 1951.

There can be very little quarrel with the general assumption that cultural evolution has roughly paralleled the biological evolution of Man. But this can be only the weakest of correlations, for *Homo sapiens* has been here a long time, during which culture has progressed to a bewildering complexity. In other words, "civilization," as we know it, has far outstripped, in rate and in integration, any natural evolutionary process. Weinert disregards this fact in one sense, perverts it in another.

The thesis of this book seems to rest upon several themes: the bodily form, in an evolutionary hierarchy, reveals the stage of intellectual development; all culture, art, and technic is bound to, or has its origin in, racial grouping. This sort of thinking provides the framework that Weinert seems interested in: the establishment of a racio-cultural scheme that sets the stage for superior vs. inferior racial categories. This is the same vicious pre-Hitlerian P. A. (I don't mean *P*hysical *A*nthropology—I mean *P*rostituted *A*nthropology) that culminated in the "master-race" dogma. One would think that years of bitter and total war should have debunked this sort of stuff. But I guess prejudice is hydra-headed.

Figs. 131–132, on p. 291, of this book are the tip-off. Fig. 131 is a picture of a member of the "Khoisanide Race" of S. Africa; Fig. 132 is that of the German

astronomer (no racial tag here!) Plassmann. The first picture is that of a coarse-featured, rather stupid face; the second of a fine-featured intelligent face. The subscript says that the stage of intellectual advancement is registered in the expression of the countenance. I could reverse this "evidence" easily by photographing a gin-sodden white man from Skid Row and comparing his picture to that of the dignified countenance of a Booker T. Washington or a George W. Carver.

I regard this book as basically unfair and biassed to the point of intellectual dishonesty. The human paleontological evidence, both biological and cultural, is so interpreted as to give an impression that racial biology is the basic cultural determinant. Other and possible factors are mentioned so casually as to be virtually disregarded. I charge the author with prejudice and with bias in the presentation of his data.

WILTON MARION KROGMAN

GENETICS AND CYTOLOGY

GENERAL GENETICS.

By Adrian M. Srb and Ray D. Owen; illustrated by Evan L. Gillespie. W. H. Freeman and Company, San Francisco. $5.50. x + 561 pp. + 3 pl.; text ill. 1952.

This textbook of genetics is rapidly establishing itself as among the leaders, if it is not the leading one already. In almost every respect its freshness of approach and its high standards of accuracy and clarity are outstanding. Graphic illustrations, new, interesting, and abundant problems, well selected references, with short comments on each, and succinct summary statements (Keys to the Significance of This Chapter) provide the student with that guidance and drill he needs if he is to develop a sound understanding of genetics rather than a superficial acquaintance with it.

The organization and presentation of the subject is also very commendable. A survey of the more classical portions of the subject is followed by a great deal of attention to problems of gene action, as one would expect from the authorship. The biochemical effects of genes, immunogenetics, and the relation of the genes to development are given expert treatment; and these subjects lead up to a consideration of the nature of the gene. The final sequence of chapters (Heredity in Populations, Genetics and Evolution, Breeding Better Plants, Genetic Aspects of Animal Productivity, and Genetics and the Welfare of the Human Individual) also deserves special praise and makes a suitable climax to the study of genetics.

In only one respect, in my own opinion, is the book rather disappointing. A science is the product of growing understanding; it is the fruit of effort by innumerable individuals whose failures, as well as successes, are instructive. The history of concepts, principles, and theories is an essential part of science and is necessary to provide the novice with perspective. Nor are these values to be achieved simply by adding a few names to the text here and there. What is requisite for human interest and scientific perspective is more than this—it demands the narration, to a judicious degree, of the experimental approaches, the lines of reasoning, the trails of research that led to outstanding discoveries. This textbook, like so many offered our students nowadays, depicts a science sprung fully panoplied and without other parentage from the head of Jove. It seems to be a direct concession to the uninformed young student who demands "Give us the facts" without possessing any recognition of the ever-changing significance of the facts. Science as human knowledge is neither impersonal nor anonymous, and we do it a great disservice when we seem to make it so.

It is perhaps too much to expect any book to be admirable in everything at once, and the blemish in the present approach is far outweighed by the numerous merits of Srb's and Owen's treatment of elementary genetics. If there was only a series of adequate supplementary booklets to deal with the development of the science—for example, with the formulation of the chromosome theory, the concept of the gene, the relation of genetics to evolutionary theory, and a number of other prime concepts—one would not need to be so fearful of the effect of a diet of "perfected" science on the mind of a student. Unfortunately, these are still lacking.

BENTLEY GLASS

QUANTITATIVE INHERITANCE. *Papers Read at a Colloquium held at the Institute of Animal Genetics Edinburgh University under the auspices of the Agricultural Research Council, April 4–6, 1950.*

Edited by E. C. R. Reeve and C. H. Waddington. Her Majesty's Stationery Office, London. £1. 0s. 0d. (paper). 152 pp.; ill. 1952.

The field of genetics, like other fields of scientific inquiry, has become subdivided into areas which are distinguished by the nature of the questions and of the techniques of investigation and analysis. The areas of genetics have shown varying spurts of growth in the last 50 years. Quantitative genetics appears now to be enjoying one of its most vigorous periods of growth. This book, containing 9 papers dealing with the theory and facts of quantitative inheritance, will stand as one of the important contributions to that growth.

The first paper, by Wright on The Genetics of Quantitative Variability, is a compact summary of the theory. Wright points out that in dealing with the genetic analysis of metrical characters the first problem is the choice of an appropriate scale of measurement. This may require a transformation of scale to achieve

additivity of genic effects and of genetic and non-genetic interactions. The next problem is to analyze the variability into components. In favorable cases, the genetic variance may be analyzed into additive gene effects, dominance deviations or allelic interactions, and non-allelic interactions. The third consideration is to estimate the number, called the segregation index, of freely segregating genetic units involved in crosses between strains or varieties differing in a quantitative character. Further problems arise from minor mutations occurring during the course of an experiment, pleiotropy, and linkage.

The second paper, by Waddington on Canalization of the Development of Quantitative Characters, briefly describes the tendency for development to yield a standard product despite fairly strong disruptive influences, either genetic or environmental.

The remaining papers, with the exception of one by Woolf and a rejoinder by Mather, deal with experiments designed to analyze or to utilize quantitative variability. A paper by Mather and Vines on The Inheritance of Height and Flowering Time in a Cross of *Nicotiana rustica* will stand as a model of design and analysis of experiments in quantitative genetics. Two varieties of *N. rustica* were crossed; the F_1 plants were selfed to produce an F_2 and were also backcrossed to both parents. By subsequent matings and repetitions of the first crosses, several generations were produced simultaneously including parents, F_1, F_2, biparental families in the third generation, first backcrosses, and second backcrosses. These were grown in two randomized blocks, each block containing 190 5-plant plots. The analysis of the data on height and flowering time proceeded largely as outlined by Wright, but with special devices introduced by Mather.

The papers by Reeve on Genetical Analysis of a Strain of *Drosophila melanogaster* Selected for Long Wings, by Robertson on Interactions Between Chromosome from Large and Small Strains of *Drosophila melanogaster*, by Cavalli on An Analysis of Linkage in Quantitative Inheritance, and by Falconer and Latyszewski on Selection for Size in Mice on High and Low Planes of Nutrition, each exhibit one or more of the experimental plans and one or more of the analytical procedures among the practically infinite variety of plans and analyses available to the student of quantitative inheritance. Cautions against accepting the theoretical models too readily are firmly though at times turgidly stated in Woolf's paper on Environmental Effects in Quantitative Inheritance.

The concepts and techniques of quantitative genetics bear a striking resemblance to the concepts and techniques of population genetics. Yet the orientation is different. The objective of population genetics may be regarded as a fuller understanding of evolution, of quantitative genetics as a fuller understanding of how to utilize the evolutionary forces in plant and animal breeding. A unification of quantitative and population genetics beyond that achieved in this colloquium is possible. This volume will immeasurably help in achieving this synthesis.

E. L. GREEN

MAMMALIAN HYBRIDS. *A Check-List with Bibliography. Technical Communication No. 10.*

By Annie P. Gray. Commonwealth Agricultural Bureaux, Bucks. 21s. x + 144 pp. 1954.

This checklist and bibliography is a fine example of what a diligent search of the literature and careful compilation can provide. It is a much-needed and very useful publication. There will of course be some omissions in every such work, e.g., the reports of the National Zoological Park in Washington have not been fully utilized—but that is not the point. Everyone who knows of additional items that ought to be included can now see that they are brought to attention and get into the next revision. The paramount matter is that someone has had the initiative to make a beginning, to assemble as many as possible of the scattered reports, to evaluate them, and then to report them succinctly.

Scientific problems by the hundreds suggest themselves as one thumbs through these pages. How few hybridizations have been tried, or if tried have been reported, among primates! Not a single cross involving gorilla, chimpanzee, or orangutan; two reciprocal crosses between gibbons, resulting in hybrids of uncertain description, viability, or fertility; a good many intrageneric and a few intergeneric hybrids within the Old World monkeys, and some intrageneric crosses among the New World monkeys; and finally a scattering of hybrids within the Lemuridae, but none among any other lemuroids. The opportunity for a real genetic program here seems almost limitless. The possibilities in other orders seem almost equally unexplored, except in a few families such as the Canidae, the Equidae, and the Bovidae in which crosses between domestic and wild species were possible. Otherwise, hybridization seems to have been determined by the exigencies or whimsies of zoos, and rarely to have been followed by fruitful genetic or morphological study.

BENTLEY GLASS

HEREDITY, RACE AND SOCIETY. *Revised and Enlarged Edition. A Mentor Book.*

By L. C. Dunn and Th. Dobzhansky. The New American Library of World Literature, New York. 35 cents (paper). 143 pp. 1952.

This highly praiseworthy popular book, which first appeared in 1946 (*Q.R.B.*, 22: 152. 1947), has been

greatly enlarged and almost completely rewritten. The general point of view adopted by the two authors is, however, unchanged, and the excellence of a clear and pungent style is thoroughly maintained. The biggest alteration is the substitution of two chapters, on Man as a Product of Evolution and on Controlling Man's Heredity, respectively, for the former single chapter entitled Group Differences and Group Heredity. The problems and difficulties of eugenics are discussed much more thoroughly than before. By omitting one appendix on Evidence for Mendel's Law, some 10,000 words of new discussion and a very useful index have been added without sensibly altering the total number of pages.

BENTLEY GLASS

CLINICAL GENETICS.

Edited by Arnold Sorsby. The C. V. Mosby Company, St. Louis; Butterworth & Company, London. $17.50. x + 580 pp. + 24 pp. + 1 pl.; text ill. 1953.

This new book is directed primarily to the attention of the physician. It is written by 32 geneticists and physicians, all of whom clearly have a great interest in and a wide knowledge of the subject. It is a very good book and goes a long way to fill a great need in medical literature. The very great progress in our knowledge of the biochemical and physiological processes of living organisms has offered an undreamed of opportunity to understand the abnormal physiology of disease. Conversely, the study of disease has often provided insight into the normal mechanism gone wrong. Genetically determined conditions lend themselves very well to this kind of study, and we are already seeing an increasingly intensive concentration on such abnormalities.

This book makes available in clear and understandable terms the principles of genetics as they apply to human beings. The book is conveniently divided into two parts, the first entitled Theoretical Considerations, and the second, Clinical. In my own opinion the first part is of more value than the second. As Sorsby has stated in his Introduction, genetic theory and method have outstripped observation, and what is needed is the collection of these kinds of data which theory suggests would be appropriate, and which methods of analysis will show to fit or not to fit definite hypotheses. The first 10 chapters are intended to provide a background of information relevant to this kind of study. Of special note are the chapter on the biometric evaluation of findings, by Gunnar Dahlberg, and the chapter on chemical genetics by D. G. Catcheside. The former is most helpful to the investigator who wishes to test the validity of hypotheses based upon his observations. The latter is an excellent exposition of current thinking on the modes of gene action and on the significance of mutant genes, which is certainly as applicable to the human organism as to microorganisms.

The remainder of the book considers genetic clinical pathology, in part by organ systems. All of the authors are not equally critical of the evidence favoring the genetic basis of the conditions they discuss, nor of the diagnostic uniformity or reliability of the material taken from the literature, but there is generally a great deal of interesting information here. In one chapter, Sorsby discusses animal counterparts of human diseases. This is a generally overlooked field; and it might pay biochemical and clinical investigators to look into these conditions, since the mechanisms involved are not likely to differ much from their human counterparts, and the experimental opportunities are better. Particularly well done are the chapters on muscular disorders, on the alimentary tract, and on the hemopoietic system. In a section of the latter, the difficult task of discussing the blood groups clearly and succintly has been accomplished.

In form and arrangement the book is pleasing and the figures and diagrams are good. It is a worthwhile addition to the library of geneticist or physician, though it seems likely that the cost of the book will prevent the wide dissemination it ought to have.

BARTON CHILDS

L'ANEMIA MACROCITICA EREDITARIA E L'IPOGENITALISMO DEI TOPI MACCHIATI. *Possibilità Speculative & Practiche della Sperimentazione sui Mutanti del Locus W. Biblioteca "Haematologica," XIII.*

By Angelo Bianchi and Carlo Manera. Tipografia del Libro, Pavia. Paper. viii + 114 pp.; ill. 1953.

This monograph summarizes in Italian the status of investigations, up to 1953, on the action of the *W*-series genes of the mouse upon blood formation, gonad development and function, and pigmentation. Approximately three-fourths of the paper is a résumé of the work of other authors, including deAberle, Grüneberg, Russell, and the group at the University of Pavia with whom the authors are associated. This summary provides a rather lengthy description of the nature of the deleterious effects of *W* and *W*^{v} for Italian readers, although it duplicates a symposium, "Fisio genetica di mutazioni pleiotropiche l'anemia macrocitica" (Symposia Genetica III), in a form slightly less useful to English-speaking audiences, since it has no English summaries and very few of the excellent photomicrographs of the published symposium.

The remaining one-fourth of the paper describes experiments of the authors attempting therapy of these deleterious genetic effects by means of transfusion; injections of liver extract, folic acid, and vitamin

B-12; treatment with hypophyseal extract, male sex hormone, and female sex hormone; ovarian transplant; and splenectomy. None of the attempts at therapy gave consistent positive results, nor any further comprehension of the basic nature of this puzzling pleiotropism.

ELIZABETH S. RUSSELL

ENDOMITOSE UND ENDOMITOTISCHE POLYPLOIDISIERUNG. *Protoplasmatologia, Handbuch der Protoplasmaforschung, Band VI: Kern- und Zellteilung.*

By Lothar Geitler. Springer-Verlag, Wien. DM. 23.50 (paper); by subscription, DM. 18.80. 89 pp.; ill. 1953.

The international series of monographs which is being issued under the sweeping title *Protoplasmatologia* is off to a splendid start with this survey of endomitosis by Geitler. It is a far cry from the days when we insisted, to the detriment of cytological progress, that in every individual of a species the number of chromosomes is constant and can be altered only through cellular mishaps. Evidence to the contrary was generally ignored until Geitler's own work, as well as that of Berger, demonstrated beyond further doubt that an increase over the diploid or usual number of chromosomes might occur regularly, as part of a well organized, physiological process.

Especially during the last two decades has there been a rapidly increasing number of publications that bear witness to the widespread, possibly universal, occurrence of endomitosis. But these publications have also uncovered the bewildering range of expression that characterizes endomitosis in different organisms and even different tissues. One need think only of the polytene chromosomes in the dipteran salivary cell on the one hand, and the polyploidy in the macronuclei of ciliates on the other, to get an inkling of the cytological and physiological implications that may be involved. It is natural that this variety of manifestations has sometimes led to errors of observation and interpretation, and that bane of cytological endeavor, nomenclature, played its nefarious role as usual.

Geitler now wisely returns to the original and inclusive concept, and here considers endomitosis as the term applied to a binary division of the chromosomes (or their equivalents) without the formation of a spindle or a division of the nucleus. Further, he is basically concerned with the process only as it occurs in the normal development of an organism, though he cannot avoid the consideration of malignant growth altogether.

There is first a concise survey of the mode of occurrence of endomitisis in different organisms, and here Geitler's astonishing familiarity with the literature shows to full advantage. In present-day biology he is a very rare cytologist who can cover both animals and plants with so authoritative a judgment. But Geitler's judicious comprehension also extends to single-celled organisms—and that puts him on a very special plane indeed. His presentation is clear and unequivocal, and he does not hesitate to voice an opinion when the difficulties of a case have prevented a final conclusion or when poor work has confused the issues.

In the section on the more general aspects of endomitosis Geitler deals with its relation to growth phenomena and differentiation. He cuts to the core of each subsidiary question as it arises and points out the paths that lie before us. It is obvious that the importance of endomitosis has been realized by but few of us, and the present book is both timely and helpful for further investigation. There is a bibliography of some 260 titles as well as an index of authors and genera.

FRANZ SCHRADER

DIE PFLANZENZELLE. *Vorlesungen über normale und pathologische Zytomorphologie und Zytogenese. Second, revised Edition.*

By Ernst Küster. Verlag von Gustav Fischer, Jena. DM. 54.00. xi + 866 pp.; ill. 1951.

That a second, revised edition of this monograph on plant cells was published 16 years after the appearance of the first edition is eloquent testimony of its scientific importance. But that the author accomplished this in spite of the loss in 1944 by fire of his cytological library, manuscripts, and many original drawings, is admirable.

Although the general plan and arrangement of the book remain the same, much new information, often replacing parts of the first edition, has been added, as have many new original illustrations. In the main the literature published before the end of 1949 has been included. Despite these extensive changes and additions, the author has retained the original framework of his lectures, by revising their contents and increasing their length.

Cytology, as pertaining to plant cells, is here considered in its broadest sense, rather than confined to a treatment of nuclear or chromosomal phenomena. In fact, the book deals with normal and pathological structures, phenomena, and processes as exhibited by all cellular constituents ranging from protoplasm, nucleus, plastids, inclusions (living and dead), vacuoles, and membrane to the origin and development of cells. Extensive bibliographies follow the major sections, and excellent indexes greatly increase the usefulness of the book. Unfortunately, the quality of the paper available for the second edition does not compare favorably with that used in the first.

Küster's monograph marks a turning point in the history of cytology, the end of the classical period and the beginning of a new phase envisaged by the author

through the development and application of new and powerful techniques (micrurgy, the electron microscope, etc.). Thus *Die Pflanzenzelle* documents not only our present knowledge of plant cells but also charts the course of future research.

THEODOR JUST

GENERAL AND SYSTEMATIC BOTANY

AUSTRALIAN AND NEW ZEALAND BOTANY.

By John McLuckie and H. S. McKee. Associated General Publications, Sydney. £ (Aust.) 4. 4s. 0d. xx + 758 pp.; ill. 1954.

This is a general textbook of elementary botany for colleges and universities, prepared for students in Australia and New Zealand. Its content is similar to that of most standard textbooks except for its illustrative material, which is drawn whenever possible from plants native or cultivated in the regions for which the book is intended. The book is in three parts, the first of which covers the basic fields of morphology, physiology, reproduction and growth. Part II is a general survey of the plant kingdom, with emphasis upon the development of life histories and the significance of the great plant groups to all of nature and especially to man. Part III contains a variety of chapters, the first of which is a general account of the nomenclature and classification of the flowering plants. Following this are chapters on heredity, paleobotany, variation and evolution, plant ecology and geography, and on the flora and vegetation of Australia and New Zealand. The final chapter is on the history of Australian botany. The book closes with a glossary and an index. It is illustrated with 276 figures, most of which are new or redrafted line drawings, while a few are half-tones.

H. M. RAUP

CONTRIBUTIONS TO THE FLORA OF VENEZUELA. *No. 1. No. 2, From Droseraceae through Umbelliferae. No. 3, From Ericaceae through Compositae. Fieldiana: Bot., Vol. 28, Nos. 1–3.*

By Julian A. Steyermark and collaborators. Chicago Natural History Museum, Chicago. (1) $4.00 (paper). (2) $4.00 (paper). (3) $4.25 (paper). (1) Pp. 1–242; ill. (2) Pp. 243–448; ill. (3) Pp. 449–678; ill. 1951; 1952; 1953.

An energetic, experienced plant taxonomist by strenuous field work adequately financially supported and by critical herbarium study has produced with 26 collaborators an outstanding contribution to the flora of Venezuela. The large collection of 8,550 numbers of plants was made by the author from December 1943 to June 1945 in different regions from the Andes to the eastern Coast Range and south to the noted endemic centers of Roraima and Duida. First, he was with the Cinchona Survey of the Foreign Economic Administration of the United States Government and afterwards under the auspices of the Chicago Natural History Museum and the Ministerio de Agricultura y Cría in Venezuela. Though valuable specimens were found, the immediate wartime objective of locating commercial quantities of wild trees of *Cinchona* with bark of high alkaloid content was not realized in Venezuela.

Published in three parts, the volume is devoted to lengthy Latin diagnoses, English descriptive notes, and 144 figures of line drawings of the author's numerous new entities, together with a few from other collectors. According to my unverified count, there are approximately 8 new genera, 564 new species (all vascular plants except 5 mosses), 61 new varieties, 19 new forms, 13 new names, 75 new combinations, and more than 25 reductions to synonymy. A few additional novelties have been published elsewhere by specialists, for example, in *Podocarpus* and the Compositae.

For a tropical country having a previously published catalog of its flora listing more than 11,000 species of vascular plants and regarded as relatively well explored botanically, the large number of new species is unexpected and may seem high, though less than 7 percent. A few of the novelties already have been reduced to synonymy and more probably will be later, but the great majority, including most of those proposed by the collaborating specialists in many families, should stand the test of time. The reviewer, just returned from a year in Venezuela, has followed the author in a few areas and in the herbarium, confirming several new species of trees, observing that very few unnamed plants had escaped notice, and benefitting from the many accurately named herbarium specimens.

This technical reference will be essential to plant taxonomists studying the flora of Venezuela and nearby countries, but it is not a manual or flora for the biologist wishing to make his own preliminary determinations. Of more general interest will be the last installment, promised in the introduction, which "will contain a comprehensive summary of the species collected in the various regions, with critical taxonomic and phytogeographical notes wherever necessary."

ELBERT L. LITTLE, JR.

FLORA OF WEST VIRGINIA. *Part II.*

By P. D. Strausbaugh and Earl L. Core. West Virginia University Bookstore, Morgantown. $1.00 (paper). Pp. 275–570; ill. 1953.

Part I of the *Flora of West Virginia* appeared in June, 1952, and covered the ferns, fern-allies, gymnosperms, and the angiosperms through the monocotyledons.

Part II takes the dicotyledons through the Leguminosae, following the Engler and Prantl arrangement of families. Judging by the Introduction to Part I, the authors intend to finish the flora with one additional fascicle.

The book is intended as a working manual of the vascular flora. It contains descriptions of all species, keys to genera within the families, and to species within the genera. Each species is illustrated with a line drawing. The nomenclature follows in general that of the eighth edition of Gray's *Manual*, and where there are departures from these names the latter are given in parenthesis. Common names are included where such names exist, and the meanings of generic and specific names are also given. Data on ranges are limited to the state of West Virginia and are based upon herbarium material and published lists. There are abundant notes on habitat, economic significance, and phenology.

The entire work will describe some 2000 species growing without cultivation in the state. A general diagnostic key to the families, and an index, are intended for a later fascicle. When finished the work will be a splendid addition to our all too scanty list of up-to-date local and state floras. It will be useful and stimulating not only within the state of West Virginia, but also in much of the central mountain region of eastern United States. Not the least of its usefulness will derive from its excellent and abundant illustrations.

H. M. RAUP

THE TREES AND SHRUBS OF THE SOUTHWESTERN DESERTS. *First published by The University of Arizona under the title: A Manual of Southwestern Desert Trees and Shrubs.*

By Lyman Benson and Robert A. Darrow; line drawings by Lucretia Breazeale Hamilton. The University of New Mexico Press, Albuquerque; The University of Arizona Press, Tucson. $8.50. x + 438 pp. + 34 pl.; text ill. 1954.

The material in this manual of the woody plants of the southwestern deserts of the United States has been presented in such a way, including such profuse illustration by colored plates, half-tones, and line drawings, that the layman should be able to use the volume effectively for locating many of the plants he will meet in the region. However, full enough keys have been included so that it should be possible definitely to identify the plants within its scope. Besides 26 half-tone plates, and nearly 50 pages of beautiful line drawings, a distinctive feature of the book is the inclusion of numerous maps, showing by a light green overprint on a black line base the distribution of important species of plants. Unfortunately, the numerals indicating certain portions of the maps are in light green, and are sometimes difficult to locate and read.

It is refreshing to find that the authors have followed a conservative policy as to recognition of species and varieties, for the "splitters" had left consternation in their wake. This attractive, beautifully printed, and generously illustrated volume should add materially to the pleasure of travel by a layman, and should give much encouragement to any who may wish to study more seriously the trees and shrubs around them. The authors are to be commended for doing such an outstanding piece of work.

ROBERT L. PENDLETON

CONTRIBUTION Á LA FLORE DU BASSIN DE LA BAIE D'UNGAVA. *Contribution of the Arctic Institute, The Catholic University of America.*

By Arthème Dutilly, Ernest Lepage, and Maximilian Duman. The Catholic University of America, Washington. $2.00 (paper). 104 pp.; ill. 1953.

The region covered by this report is in the northern part of the Labrador peninsula, south of Ungava Bay. It embraces the upper part of the valley of the Koksoak River, and the lower valleys of its principal tributaries, the Melezes and the Kaniapiskau. The base for field operations was Fort Chimo, which was reached by air. The report contains a general topographic and botanical description of the region, a review of the phytogeographic problems raised by the floristic study, an annotated list of species collected, a list of references, and an index to plant names. Nineteen text figures illustrate the paper, 18 of them dot maps showing the known ranges of certain species in Quebec, Labrador, and Newfoundland. The list contains 283 taxonomic entities. Notes include the citation of specimens, some information on habitat, and occasional discussions of taxonomic or geographic problems. Of particular interest is the section on geographic considerations, wherein the authors attempt a percentage classification of all the plants according to the areal characteristics of their ranges. They present, further, some significant differences in range characteristics between Old and New World populations of the same species.

H. M. RAUP

FLORE ET VÉGÉTATION DE L'EQE GROENLAND, II. *Expéditions Polaires Françaises; Missions Paul-Emile Victor. Actualités Scientifiques et Industrielles, 1180.*

By H. de Lesse. Hermann & Cie, Paris. 1,000 fr. (paper). iv + 136 pp. + 26 pl., 1 folded map; text ill. 1952.

This paper is Part 2 of a report on French expeditions

to Greenland, the first having dealt with glacial and periglacial phenomena, and the third with the geomorphic development of the island. The present volume reports on botanical work done in the field season of 1949. The region covered is on the west coast of Greenland in the vicinity of Eqe, between latitudes 69° 42′ and 69° 48′ N. Eqe is on the mainland east of the island of Disko.

A short introduction outlines previous botanical work and the general nature of the field work done in 1949. The first chapter describes the terrain and gives a general description of the principal plant environments. Chapter 2 is a catalog of the flora, in which 124 species are listed, together with their frequencies, locations, and general ecology. Chapter 3 deals primarily with descriptions of plant communities—their physiognomy, floristic content, and extent. There are also some detailed descriptions of soils and soil profiles. The fourth chapter describes further characteristics of soil and general environmental conditions, particularly those of climate. Chapter 5 contains a study of the local distribution of species of the major geographic affinities, and describes also the plant life of the various kinds of structural soils that were encountered. The last chapter discusses the broader geographic problems involved in the flora of Greenland. The book closes with a bibliography.

There are two appendices, the first of which is a catalog of the bryophytes collected by de Lesse, prepared by Mme. S. Jovet-Ast, and the second is a catalog of lichens prepared by R. de Vilmorin and P. Ozenda. There is an alphabetical index to Latin names, and a brief abstract in English. The book is profusely illustrated with pen and ink sketches, and with 26 excellent half-tone photographs. A detailed map of the region studied is included.

H. M. RAUP

A REVISION OF THE NORTH AMERICAN SPECIES OF OXYTROPIS DC. *Proc. Calif. Acad. Sci., 4th Ser., Vol. XXVII, No. 7.*

By R. C. Barneby. California Academy of Sciences, San Francisco. $2.00 (paper). Pp. 177–312; ill. 1952.

All those who have tried to name specimens in the rather small but difficult genus *Oxytropis* as it occurs in North America will welcome this discerning revision. Although there has appeared a sizable literature on various groups of the species, or on those that occur in various regions, this appears to be the first attempt at a general treatment for North America since the synopsis of the genus published in 1884 by Asa Gray. It is of interest to note, as Barneby says, that although exploration and study have modified the outline here and there during the period since Asa Gray wrote, they have "scarcely disturbed the basic specific concepts" defined by that remarkable student. Materials for a monograph of the genus for the North American Flora series appear to have been accumulated by P. A. Rydberg, and a key to the species was published by him. Judging by his published comments, and by the specimens he annotated, he would have recognized about 70 North American species. In contrast, Barneby recognizes only 22 major species complexes, with 21 minor taxonomic units within them.

Study for Barneby's revision began with the species known to occur in the Rocky Mountains and the Great Basin, but after he had investigated all the extralimital entities that had to be considered, he found that he had covered nearly all the North American species. Hence his expansion of the revision to cover the entire continent. He states that for most of the arctic and subarctic material he has accepted the conclusions of those better equipped by experience to deal with them.

The revision contains sections on the validity of the genus, its phylogeny and infrageneric divisions, the criteria used in the delineation of species, and the problem of hybridization. The principal American herbaria were consulted freely in the course of the study. The taxonomic treatment contains a key to the major species, and keys to the varieties within the species. There are full specific descriptions, synonomy, discussion of attendant taxonomic problems, and citations of representative specimens. Range maps are included for most of the entities that are mentioned. One new species and 3 new varieties are described, 10 new nomenclatural combinations are proposed, and there are 2 new combinations that involve change of status. Fourteen names are listed as excluded or as representing imperfectly known species. The paper closes with an index to names.

H. M. RAUP

A REVISION OF THE NORTH AMERICAN SPECIES OF LATHYRUS. *Biology Series, Vol. 15, November, 1952.*

By C. Leo Hitchcock. University of Washington Press, Seattle. $2.50 (paper). 104 pp.; ill. 1952.

This paper is the result of extensive studies in field, herbarium, and garden. The author states in his introduction that his research "has led to the belief that many of the species interbreed freely, producing hybrid populations of great variability." The present paper is designed to bring existing knowledge of the species up to date, and to report the results of preliminary experimental studies in the cytotaxonomy of the species. Chromosome numbers for 19 species now under cultivation are reported.

The paper includes discussions of morphological characters that are of taxonomic significance, relationships of the species, and some notes on experimental

hybridization. Keys, synonymy, and descriptions are given for all species and lesser taxonomic units, with notes on type localities and general geographic range. Specimens are cited in an Index to Collections Seen, arranged alphabetically by collectors, and in a list of representative collections examined, arranged by species. Excellent line drawings illustrate the native species, and spot maps give their ranges. Two charts illustrate the probable relationships of the species, and there is an index to names. Two new species, one new subspecies, and one new variety are described, and 16 new nomenclatorial combinations are proposed.

H. M. RAUP

THE FERN GENUS DIELLIA. *Its Structure, Affinities and Taxonomy. Univ. Calif. Publ. Bot., Vol. 26, No. 1.*

By Warren H. Wagner, Jr. University of California Press, Berkeley and Los Angeles. $3.00 (paper). Pp. 1–212 + 21 pl.; text ill. 1952.

This exemplary monograph of a small, but exceedingly difficult, genus of leptosporangiate ferns demonstrates clearly how much can be learned from intensive studies of critical groups. Endemic in the larger Hawaiian Islands, these inconspicuous ferns are relatively rare shade plants, growing in disturbed parts of dry, rocky gulches in forest and scrub between 700–4000 feet elevation. The 8 or so described species are now placed in 5, one with two forms, or are discarded. Extensive field, herbarium, and laboratory studies enabled the author to observe and describe all stages in the life history of these ferns as well as their morphological variation. Although variously and doubtfully assigned in previous classifications of ferns, the author was able to confirm Copeland's conclusion that *Diellia* is of asplenid origin, and that it belongs to the rock spleenworts typified by the world-wide *Asplenium trichomanes*. Because of the numerous comparisons drawn between *Diella* and other groups of ferns, this monograph is of general interest to all students of the taxonomy, morphology, and evolution of ferns.

THEODOR JUST

ORCHIDS OF GUATEMALA. *Part 2. Fieldiana: Bot., Vol. 26, No. 2.*

By Oakes Ames and Donovan Stewart Correll. Chicago Natural History Museum, Chicago. $5.00 (cloth); $4.00 (paper). Pp. 399–727; ill. 1953.

The first part of this paper, containing introductory material and keys to all the genera of orchids known to occur in Guatemala, was reviewed in *Q.R.B.*, 28: 413 (1953). Part 2 completes the orchid flora of Guatemala by describing the remaining 60 genera of the tribe Kerosphaereae. The two parts have been printed as Nos. 1 and 2 in Vol. 26 of *Fieldiana*, and are therefore paged consecutively. Part 2 closes with a complete index of all scientific names used in the whole work.

H. M. RAUP

HOW TO KNOW THE GRASSES. *Pictured-Keys for Determining the Common and Important American Grasses, with Suggestions and Aids for their Study.*

By Richard W. Pohl. Wm. C. Brown Company, Dubuque. $2.00 (spiral-bound paper); $2.75 (cloth). iv + 192 pp.; ill. 1954.

From the beginning of the systematic study of plants, grasses have, with few exceptions, been avoided as too difficult for average students of botany. Grasses are specialized in their reduction of flowering parts to the bare essentials—no calyx, no corolla, only a pistil and stamens. Specialized leaves in the form of small bracts protect the flower and aid in the distribution of seed. That a flower had a calyx and corolla was so fixed an idea that the spikelets of grasses or their parts were interpreted as calyx and corolla by Linnaeus himself and others up to 1820, and even by the American botanist Elliott in 1824. This misconception so confused botanists that relatively few undertook the study of grasses. Students were rather dissuaded even from trying.

Finally, in this country, Vasey's *Grasses of the Southwest* (1890–1891) and *Grasses of the Pacific Slope* (1892–1893), beautifully illustrated, published by the Department of Agriculture and widely distributed, stimulated the study of grasses in the United States. In this country, with one of the greatest grasslands of the world, grasses have at last come into their own, though still deemed very difficult by some students when the study of grasses is "required."

R. W. Pohl's book is a painstaking effort to make a key to our grasses without using the terms and "key characters" to which some students object. Only some 293 kinds are keyed out, but they include all the common or important species and all the genera. To struggle through multitudes of *Panicum*, *Muhlenbergia*, and *Poa* might easily discourage a beginner.

There is a key to tribes, with helpful figures, but no key to genera. Brief descriptions and excellent figures reward one when he reaches a species. A beautiful little tailpiece on p. 84 represents *Bouteloua eriopoda*, but is without name and is not referred to on p. 142, where this species is described. The drawings explaining the structure of grasses and the little drawings in the keys are excellent and helpful, except that in *Panicum* the spikelets are not drawn to scale and measurements are not given in the keys. Hence the tiny spikelets of *P. implicatum* and *P. lindheimeri*, shown larger than that of *P. scoparium*, are misleading. Size of spikelet is one of the distinguishing characters in *Panicum*.

The effort to avoid difficulties for the student has resulted in a few slips in morphology: "Some or all spikelets inclosed in bony beads or spiny burs" (p. 15); when only in *Coix* are pistillate spikelets inclosed in bony "beads." In *Buchloë*, included in the foregoing (and again on p. 131), "pistillate spikelets [are said to be] inclosed in bead-like bodies"; but actually the spikelets are not inclosed, but are in a short spike. The thickened indurate rachis and the broad indurate second glumes, divided into 3 stout green teeth at the summit, form a hard white structure composed of the rachis and the spikelets themselves.

"Perfect spikelets inclosed in burs covered with hooks or spines" is to include *Tragus berteronianus* and *Cenchrus pauciflorus*. Yet in *Cenchrus* the spikelets are inclosed in spiny burs composed of reduced coalesced branchlets, whereas in *Tragus* the second glumes of the two lower spikelets, with 3 thick nerves bearing a row of stout hooked hairs along each side, form the halves of a little bur. That is, the spikelets themselves form the "bur"; they are not inclosed. It is of interest that Linnaeus himself included *Tragus racemosus* (as *Cenchrus racemosus*) in *Cenchrus* in the *Species Plantarum* 1049 (1753). *Echinaria capitata* was also included in *Cenchrus*, the "spines" in this case being the pointed lobes of the lemmas. Linnaeus' generic description of *Cenchrus* (*Gen. Pl.*, ed. 2, 493. 1742), however, points conclusively to *Cenchrus echinatus*. That was his type, but he placed other spiny things with it.

Little maps indicate the distribution of each species. It will be interesting to learn how well this type of key succeeds. To an old agrostologist it proved difficult. But the drawings will identify a good many grasses.

A few new "common names" are proposed: "cocklebur grass" for *Tragus berteronianus;* "peanut grass" for *Amphicarpum purshii*, with large underground spikelets; and "sack grass" for *Sacciolepis striata*. An Index and Pictured Glossary contains numerous illustrations.

AGNES CHASE

PLANT PHYSIOLOGY

WITHIN THE LIVING PLANT. *An Introduction to Plant Physiology.*

By Erston V. Miller. The Blakiston Company, New York and Toronto. $5.00. x + 326 pp.; ill. 1954.

This new textbook in plant physiology is superficially a very attractive book. The style is clear and direct, the pictures, diagrams, and print are all pleasingly set out, and very many aspects of the field are at least touched on. The first chapter, on Plant Physiology in Everyday Life, is quite absorbing, and indeed throughout the book there can be found very interesting and well-presented case histories of practical problems in plant physiology. In many respects other than these, however, *Within the Living Plant* is a very inadequate and irritating book, and it will probably not be very well received.

The majority of the material is presented as a series of direct, simple, entire'y unequivocal statements. Most irritating are the times when these simple declarations are made about "facts" that are actually only tentative proposals, or one hypothesis out of several alternatives, or even untrue. For instance, it is definitely stated that "mitochondria have been observed to change into leucoplasts, chloroplasts, and finally into chromoplasts" (p. 12). The fact is that this is only a hypothesis, and is far from general acceptance as a proven fact. Surely in a textbook it is up to the author to give some slight evaluation of a controversial statement, some sort of indication that this is as yet only a tentative truth.

In the section on respiration, it is clearly stated that "no experimental evidence has been obtained which proves that these [the tricarboxylic acid or citric acid] cycles exist" (p. 217). Following this piece of misinformation, there is a presentation of the considerably outdated Thunberg and Knoop cycle, involving the condensation of two acetates to form succinate. This section of the book appears to have sacrificed accuracy for the sake of simplicity.

The chapter on respiration is notable for other omissions, as well. The fact that respiratory activity seems to be localized and organized in the mitochondria is an outstanding and stimulating concept of recent physiology. This fact is not mentioned in the chapter, and only briefly and inadequately alluded to elsewhere. The unique plant terminal oxidases are barely mentioned in one paragraph, and the relation of the oxidases to the other components of respiration is left in a very cloudy state.

In discussing the efficiency of photosynthesis (pp. 123–125), Miller states quite unequivocally that "a controversy once existed regarding the efficiency of the photosynthetic process" and goes on to explain in considerable detail that Warburg has shown and it is now agreed by all, that four quanta of light are required to reduce one molecule of CO_2. This is not only untrue, but is also grossly unfair to the Emerson school of thought. It is beyond the scope of the present review to estimate which hypothesis has the firmest grounding at the moment, but certainly the ten-quantum theory is as much alive at the present time as the four-quantum theory, if not more so.

Aside from the distortions incorporated in the book, a very fundamental weakness is a too frequent failure to present a unified larger picture. In far too many sections, the material consists of a series of isolated facts, or even results of particular experiments. Since most of the experiments and many of the single facts cannot be included in a short text of this sort, the student is left to derive the larger picture for himself, and on the basis of an inadequate amount of detail. Two examples out

of very many will suffice to illustrate this kind of failure to tie the whole picture together. In the chapter on Vitamin Requirements, Miller has lumped together the "vitamin requirements of roots" (thiamin, niacin, pyridoxine), and in another paragraph, the "vitamin requirements of embryos" (thiamin). He says nothing of the fact that roots or embryos of different species or varieties will differ markedly in regard to their vitamin needs. Further, these are presented as single, isolated facts. The unifying concept in this area which alone could orient the student (who does not have all the background information available) is that although all tissues probably require the same chemical compounds in varying amounts, some tissues are deficient in synthetic ability. Instead of finding some simple statement to this effect, the student is left to guess the significance of the vitamin requirements that are so clearly and simply stated. A similar example is found in the discussion of the culture of excised embryos. Here the most stimulating concept—that of a stepwise increase in the synthetic ability of the embryo—is entirely omitted. Instead, the reader is left with the single, uncorrelated fact that *Datura* embryos require coconut milk in order to grow. In these two cases, as time and time again throughout the book, there is either an inadequate evaluation and correlation of the material presented, or none at all.

Finally, one may take exception to the almost uniformly dogmatic style of this book. The general impression one gains is that most of the problems concerning the physiology of plants have been solved already, and the most interesting part of the field will be in applying known principles to interesting and difficult practical problems. Basic research in plant physiology, as in any living science, deserves a presentation that will stimulate the imagination, and leave many questions half-answered and offer at least some carefully labelled guesses as to the future. On the other hand, ***Within the Living Plant*** seems to go to some lengths to avoid posing difficult or unanswered questions about fundamental mechanisms, and concentrates instead on a presentation of too often uncorrelated, unevaluated, but already discovered, details. Combined with those instances of actual distortion (which include at least as many more as the ones specifically mentioned), it is unlikely that this book will find general acceptance until materially revised.

ANDRÉ T. JAGENDORF

ANALYTIC STUDIES IN PLANT RESPIRATION.

By the late F. F. Blackman. Cambridge University Press, New York. $7.50. x + 232 pp. + 1 pl.; text ill. 1954.

The late F. F. Blackman was an almost legendary person to plant physiologists of this country. Primarily by word of mouth from his pupils, he was known to be a brilliant, respected, and influential scientist of Great Britain. These same pupils today dominate the field of plant respiration in Great Britain, and even abroad. Although Blackman had published a few papers on the respiration of apples, it seemed generally agreed that the work for which he was most famous had never been published. Furthermore, legend had it that these studies, so important, so outstandingly influential in training the minds of a number of the best British scientists, had all been conducted on a total of 21 apples.

It is a pleasure, therefore, to see this volume appear, and to find that all the details of the legend are fully corroborated. The book is a compilation of 9 papers, 3 of which have been published previously, and 6 of which have not. Eight out of the 9 papers, and a part of the ninth consist entirely of an analysis of the respiration of 21 Bramley's Seedling Apples, observed during the course of less than one year in storage.

The actual experimentation consisted of taking separate apples out of storage after varying lengths of time, putting them in a device which could measure their carbon dioxide output continuously, and then subjecting them to gas mixtures from the composition of air down to 100% nitrogen. The techniques would probably be considered old-fashioned and unnecessarily slow and laborious in most laboratories today. The data obtained do not seem at first to be especially interesting or revealing—indeed, on the surface, very many scientists would conclude from them only (a) that apples respire, (b) that there is a large range of variation between the respiration of different apples, and (c) that the oxygen pressure has various effects on the respiration of apples.

It is in the process of analyzing the data, however, and building a logical superstructure of theory from the observed facts that Blackman showed his true brilliance. All the difficult, tedious data are collected, compared, and then sorted out, disentangled, and put in order, and finally a compellingly logical and original theory is developed to account for the now meaningful and correlated facts. The whole process is an exercise in mental virtuosity of a most unusual kind. The great influence that Blackman had is now easily applicable, and the collection of papers leaves one with much admiration for the work of a great and patient mind.

Although some of the procedures used are still open to criticism, and although in the present era of biochemistry it might seem very indirect and inconclusive to do nothing more than measure the total respiration of single intact fruits, still a large part of the conclusions and theories which Blackman developed are of contemporary interest. Some of them might profitably be tested with the more direct methods now available.

The most important contribution of this volume, nonetheless, is probably the same gift that made Blackman a great teacher. This is a remarkable demonstration of what can be done with raw and apparently indigestible material. It should be a lesson to very many

people who publish research, that hard and painstaking thought, slow, careful analysis, and a great effort at clarity of presentation can make the most difficult set of data acquire meaning and become a much more important contribution in the long run.

ANDRÉ T. JAGENDORF

ABNORMAL AND PATHOLOGICAL PLANT GROWTH. *Report of Symposium held August 3 to 5, 1953. Brookhaven Symposia in Biology No. 6.*

Brookhaven National Laboratory, Biology Department, Upton, L.I. $2.10 (paper). viii + 304 pp.; ill. 1954.

The title of the symposium given at Brookhaven in August of 1953 is a very general one, and the papers correspondingly cover a large variety of topics. The kinds of growth reported on range from normal stem, root, and leaf growth to tumors induced by viruses, bacteria, insects, or interspecific hybridization, and to the manifold abnormalities or teratomas induced by viruses or ionizing radiations. The basic picture that emerges is that of a stimulating, although preliminary, series of attempts to understand some of the chemical and physical mechanisms underlying the production of morphologically observable growth phenomena.

Perhaps the most interesting studies are described in two papers on crown gall disease, by Richard Klein and Armin Braun, respectively. Their recent experiments present an elegant picture of a series of discrete, stepwise changes, starting from the inoculation of pathogenic bacteria into a normal plant stem, and ending with the appearance of tumorous plant cells, capable of continued pathological proliferation in the complete absence of bacteria. One of the most challenging questions in this area is that of the nature of the continued stimulus for proliferation present in the final tumor cells, and not present in normal cells. A number of imaginative experiments have given suggestive answers, in these two papers. Unfortunately (or interestingly enough), it would appear that different experiments as yet suggest different answers.

Normal growth processes are considered in the papers by R. H. Wetmore and by F. Skoog. Wetmore is concerned primarily with the abilities of excised shoot apices to achieve full development. Fern apices have grown consistently well when removed from the plant and placed in sterile culture. However, the nutritional requirements (as related to the morphological organization) of angiosperm shoot apices are found to be more exacting, and must still be determined in detail.

The work reported by Skoog deals with a variety of tissue responses, all concerned with the function of auxins and nucleic acid components in the normal growth of plant cells. Those recent contributions of his laboratory presented here include a revealing crack at the thorny problem of root response to auxin, a correlation of nucleic acid levels with bud or root inhibition vs. growth, an elegant demonstration of the different nutritional requirements for root meristem initiation vs. shoot meristem initiation in tobacco, and an analysis of the factors needed to make resting cells of tobacco stem pith resume growth and cell division. This latter work has reached the point where it is possible to show that there is a specific nutritional requirement (of nature still unknown) for cytokinesis, different from the stimulus (auxin) for cell enlargement and karyokinesis. Elucidation of the nature of the factor for cytokinesis will be of great importance for a further understanding of the mechanism of cell division; and eventually, of many if not most morphogenetic problems.

A creative set of experiments is described by LaRue. He has taken haploid female gametophyte tissue from the cycads, liberated it from the seed, and gotten extensive development in culture, including regeneration in the form of the sporophyte. Perhaps more remarkable, it has been possible to get pollen from *Zamia*, *Taxus*, and *Ginkgo* to undergo development far beyond the normal limits of pollen tubes; in one case, up to possibly unlimited growth. These experiments may be disturbing to concepts of the orderly, predetermined alternation of generations, but they are of considerable interest in the physiology of growth and development.

Physical and chemical characteristics of the wound tumor virus are described by Brakke, Vatter, and Black. This virus is one of the few that has alternate hosts in the plant and animal kingdoms; and so far it appears to be identical whether taken from the insect or the plant host.

The morphology of many virus disease symptoms is described in a paper by Kunkel which, like the one by Gunckel and Sparrow describing a vast array of morphological aberrancies produced by ionizing radiations, may provoke thought regarding the mechanisms that underlie the symptoms. Both viruses and radiations seem to be able to cause a large number of irregularities similar to or duplicating abnormalities arising from other causes.

Another paper that is stimulating, as much for the unresolved problems in the system as for what has been discovered, is that on the tumors that occur with such fascinating regularity following various interspecific crosses among members of the genus *Nicotiana*. These crosses are itemized, and some comparative physiological experiments described by Kehr and Smith.

Other papers include studies of the nutrition of plant tumors in culture, by Riker and Hildebrandt, and also by Nickell; nonspecific inhibitions of tumor and plant growth with various reagents, observed by DeRopp; a study of the production of an insect gall, by Beck; a classification of abnormal plant growths, presented by Bloch; and a comprehensive review of the morphogenesis of leguminous root nodules, by Allen and Allen.

ANDRÉ T. JAGENDORF

PASTEUR'S STUDY OF FERMENTATION. *Harvard Case Histories in Experimental Science. Case 6.*

Edited by James Bryant Conant. Harvard University Press, Cambridge. $1.00. iv + 57 pp. 1952.

THE FORMATION OF ASPARAGINE IN ETIOLATED SEEDLINGS OF LUPINUS ALBUS L. *Bull. Conn. agric. Exp. Sta., No. 553.*

By A. N. Meiss. The Connecticut Agricultural Experiment Station, New Haven. Free upon request. 74 pp.; ill. 1952.

ECONOMIC BOTANY

KULTURTECHNISCHE BOTANIK.

By Fritz Jürgen Meyer. Naturwissenschaftlicher Verlag, Berlin-Nikolassee. DM. 9.00. 264 pp.; ill. 1951.

Representing the outgrowth of a course in this new aspect of practical botany given by the author since about 1940 in the Institute of Technology at Braunschweig, this book is the first textbook of its kind and might well bear the subtitle "Botany for Civil and Agricultural Engineers." For this reason it is a valuable contribution, as it contains the first summary of the widely dispersed literature of this field as interpreted and integrated by the author with his own observations and findings. *Kulturtechnische Botanik* is actually an auxiliary science through which scientists of such diverse interests as civil and agricultural engineers, agronomists, plant ecologists, soil men, and others find a common meeting-ground, and is thus quite different in character and content from biological engineering as the term is commonly understood in the United States. It is understandable and justifiable that a country as densely populated as Germany for so many centuries should give attention to land that might be claimed as arable or be otherwise improved, or that highways and other public works (airports, stadia, etc.) be properly placed and built on sites, the geological and ecological features of which are understood and improved in accordance with the best available knowledge. Although much information found in this book can, mutatis mutandis, be applied in other countries, local and regional differences will undoubtedly necessitate considerable readjustment and reevaluation before major construction problems or agricultural improvements can be undertaken with impunity.

THEODOR JUST

PHENOLOGY AND THERMAL ENVIRONMENT AS A MEANS FOR A PHYSIOLOGICAL CLASSIFICATION OF WHEAT VARIETIES AND FOR PREDICTING MATURITY DATES OF WHEAT, *Based on Data of Czechoslovakia and of Some Thermally Analogous Areas of Czechoslovakia in the United States Pacific Northwest.*

By M. Y. Nuttonson. American Institute of Crop Ecology, Washington. $3.00 (paper). 108 pp.; ill. 1953.

"The use of the remainder indices or day-degree summation system appears to have yielded fairly consistent results for this study of wheat." Measurements were made of the year-to-year and station-to-station variation of day-degree summations (above a 40°F. base) and summations of photo-thermal units, computed for various phenological events of wheat.

THE SECRET OF THE GREEN THUMB.

By Henry T. Northen and Rebecca T. Northen. The Ronald Press Company, New York. $5.00. x + 432 pp.; ill. 1954.

As the authors state, this book has been written to give gardeners in a simple, yet scientific, manner those facts about plants on which all gardening methods must be based. They have successfully described and illustrated the features of plants of all the broad groups, and how they behave; how these groups appear; and how they pass on their characteristics to their descendants. Considerable space is given to pests, diseases, viruses, and their control. This book closes with brief considerations of plant communities and conservation principles. The language is simple, the explanations clear. Some of the half-tones are not as distinct as one might wish.

ROBERT L. PENDLETON

GARDENING WITH NATURE. *How to Grow your Own Vegetables, Fruits and Flowers by Natural Methods.*

By Leonard Wickenden; Introduction by Paul Sears. The Devin-Adair Company, New York. $4.95. xvi + 392 pp.; ill. 1954.

While the author claims there is evidence of some almost magical effects from the use of composts, as a chemist he realizes the sound value of "mineral" plant food, and does not associate himself too closely with the "organic school." Yet he rightly emphasizes the importance of composts, their place in the activities of the amateur gardener, and describes their preparation. This book is based upon common sense—as the author says, "skill in gardening comes of thought, trial and error, patience, persistence, and labor." For a serious book on gardening, it provides too few botanical names or illustrations. A timely warning is included on the dangers of modern, highly poisonous insect sprays. Other topics which are considered are as follows: the limitations of soil analysis; soil conditioners and earthworms; poultry raising to supply manure for better compost making; attracting birds to the garden; types of power cultivators; home-grown garden seeds; and how to quick freeze garden products.

ROBERT L. PENDLETON

FARMING WITH NATURE.

By Joseph A. Cocannouer. University of Oklahoma Press, Norman. $2.95. x + 148 pp. 1954.

This is a plea for a combination of sound practices of organic farming with a reasonable use of appropriate chemical fertilizers. This is a laudable endeavor, but the author's superficial and rather ecstatic treatment of the subject leaves the reader rather bewildered. Practical suggestions of what to do, and how, would be more helpful to the struggling gardener who wants to have a green thumb, than such a panegyric on "maintaining an unbroken, dynamic fertility chain in the land."

ROBERT L. PENDLETON

WARTIME AGRICULTURE IN AUSTRALIA AND NEW ZEALAND, 1939–50.

By J. G. Crawford, C. M. Donald, C. P. Dowsett, D. B. Williams, and A. A. Ross. Stanford University Press, Stanford. $7.50. xiv + 354 pp. + 8 pl.; text ill. 1954.

In this publication the following topics are described by important agricultural officials who were in office in Australia and New Zealand during the war: important characteristics of the pre-war agricultural production and export trades of the two countries; the changes made during the progress of the war and under the pressure of the increasing shortages of shipping, both as affecting the delivery of essential fertilizers and other agricultural supplies to the producing regions; the kinds and amounts of foods and clothing materials which could be delivered to Britain; and some of the post-war adjustments.

ROBERT L. PENDLETON

VEGETABLE GROWING. *Second Edition.*

By James Sheldon Shoemaker. John Wiley & Sons, New York; Chapman & Hall, London. $6.00. vi + 515 pp.; ill. 1953.

Vegetable Growing is a very complete text on a subject of increasing interest and importance. The volume is current and well documented with more than 450 references. The chapter on seed production contains information not readily available elsewhere in a single text. The thorough treatment accorded each crop, from a discussion of its origin through planting, cultural practices, irrigating, fertilizing, controlling insects and diseases, harvesting, and marketing, indicates that the author is quite well versed in the field of vegetable crops. Treatment of the physiology of plant development adds greatly to a better understanding of the characteristics of the various crops. In the chapter on root crops, Shoemaker discusses the anatomy and developmental morphology of the roots and provides detailed descriptions and comparisons of the principal varieties of each crop. The concept of heat units, degree days, or degree hours required to bring a crop to maturity is presented in the chapter on Legumes or Pulse Crops. This concept is now widely used for more accurately predicting harvest dates for cannery or freezer crops. The inclusion of storage and freezing temperatures for each vegetable is valuable information for the producer as well as the processor.

The book abounds with interesting side lights, such as the report that during the great plague of London the only places immune from the contagion were the onion and garlic shops; or that the Israelites wandering in the wilderness complained bitterly to Moses because they did not have the vegetables they were fond of, namely, cucumbers, melons, leeks, onions, and garlic.

The detailed, authoritative presentation of the latest information in the field of vegetable crops marks this as one of the most outstanding texts in the field. It belongs on the bookshelves of vegetable crop students and faculty alike, as well as of county agents, operating farmers, home vegetable gardeners, and others interested in vegetable growing.

C. E. MINARIK

GROWING FRUIT AND VEGETABLE CROPS.

By Thomas Jesse Talbert. Lea & Febiger, Philadelphia. $4.50. 350 pp.; ill. 1953.

Growing Fruit and Vegetable Crops is a textbook written with the undergraduate horticulturist in mind. The subject matter is arranged in chapters of suitable length to constitute individual lesson assignments. Editing is faulty. There are many annoying instances of plural or compound subjects with singular verbs that have escaped both the author and editor.

The book affords many interesting sidelights such as those on the Plant Patent Law, rodent control, and the use of wind breaks. The author treats such subjects as budding and grafting, cultural practices, and the pruning of fruit trees. Chapters on strawberries, grapes, and cane fruits include treatment of such subjects as disease and insect control, cultural and propagation methods, and the selection of proper varieties for home and market. The chapters on vegetable production discuss perennial and annual vegetables. Approximately one-half to two pages are devoted to each crop species depending on the importance of the particular crop. The value of irrigation is pointed out, along with a discussion of the advantages and disadvantages of the various irrigation systems. A full chapter is devoted to white potatoes and sweet potatoes, while other solanaceous crops are also treated separately. Watermelons and muskmelons, although generally regarded as fruits by the public, are treated as vegetables by the present author because of their great similarity to the cucumber. A chapter on Vegetable Disease and Insect Control contains recommendations for the use of some of the

newer pesticides. The final chapter deals with marketing and storage of vegetables and fruits.

The book as a whole covers a broad field and touches lightly on many subjects. It is well illustrated and would serve as a good textbook for a beginning course in horticulture.

C. E. MINARIK

ADVANCES IN AGRONOMY. *Vol. V. Prepared under the Auspices of the American Society of Agronomy.*

Edited by A. G. Norman. Advisory Board: J. E. Adams, G. W. Burton, J. E. Gieseking, I. J. Johnson, Randall Jones, C. E. Marshall, R. Q. Parks, and K. S. Quisenberry. Academic Press, New York. $8.80. x + 422 pp.; ill. 1953.

The first contribution to this volume is an extensive survey of 150 pages devoted to the subject, A Half-Century of Wheat Improvement in the United States, by S. C. Salmon et al. It tells how plant breeders have met the need for better varieties resistant to disease, capable of yielding a higher quality of flour, and agronomically adapted to special regions. In the second paper, F. E. Broadbent discusses The Soil Organic Fraction, and not only explains the very remarkable properties of soil organic matter ascribed to it by some, but shows that present knowledge about it is quite inadequate to account for the proven good effects (31 pp.). O. R. Neal, in 24 pages, considers the subject of Soil Management for Conservation and Productivity, and stresses the point that cultivation destroys soil structure, whereas organic matter restores it. Other contributions include: Progress in Agricultural Engineering, 34 pp. (L. W. Hurlbut); The Changing Pattern of Agronomy and Horticulture in Canada, 62 pp. (R. R. McKibbin); and Chemical Weathering of Minerals in Soils, 89 pp. (M. L. Jackson and G. Donald Sherman). The latter places in perspective a large number of recent studies.

ROBERT L. PENDLETON

FIELD CROP PRODUCTION. *Agronomic Principles and Practices.*

By Harold K. Wilson and Will M. Myers. J. B. Lippincott Company, Chicago, Philadelphia, and New York. $6.00. viii + 674 pp.; ill. 1954.

This book has been designed as a textbook for agricultural colleges in the United States, hence questions follow each chapter. Wisely, pastures, pasture plants, and management are treated by regions and in considerable detail. Since such subjects as climate, soils, and fertilizers have been treated inadequately, it would seem better to have omitted them altogether. Rice, such an unique and increasingly important world crop plant, deserves a less inadequate treatment, because of the radically different methods of production usually employed. Other topics treated include: weeds and weed control; plant breeding and crop improvement; and the certifying of good seed.

Bleeding of illustrations increases their effective area and is a welcome improvement. However, the quality of the half-tones and their legends and by-lines leaves much to be desired.

ROBERT L. PENDLETON

TOBACCO DICTIONARY.

Edited by Raymond John. Philosophical Library, New York. $5.00. xiv + 200 pp. + 5 pl. 1954.

This book contains more than a thousand technical, manufacturing, and trade terms, and many foreign and unusual slang expressions relating to tobacco raising, its forms and its uses.

COCOA. *Cultivation, Processing, and Analysis.*

By Eileen M. Chatt. Interscience Publishers, New York and London. $8.50. xiv + 302 pp.; ill. 1953.

A comprehensive, well-documented treatment of this increasingly important crop and industry, by a member of the staff of the British Food Manufacturing Industries Research Association. This book is a useful introduction to the understanding of an important tropical product, and how it is produced. Horticultural varieties, methods of cultivation, diseases and pests, and problems and methods of control of a peasant-produced crop are described; the customary empirical methods of manufacture and analysis are given. Statistics of production and outline maps of the world showing producing areas are included.

ROBERT L. PENDLETON

THE UTILIZATION OF SUGAR CANE BAGASSE FOR PAPER, BOARD, PLASTICS, AND CHEMICALS. *Second Edition. An Annotated Bibliography. Technological Report Series, No. 8.*

Compiled by Clarence J. West. Sugar Research Foundation, New York. Free upon request (paper). 200 pp. 1952.

The enormous magnitude of the literary output of certain fields of applied science and technology is apparent at a glance from the extent of the present bibliography. About 130 new papers are cited in this edition, which replaces one of July, 1951. The total number of papers listed is 541, of which 437 deal with the utilization of bagasse for pulp, paper, and board. There are also listed 13 scientific reports and 8 technological reports on the subject.

PROCEEDINGS OF THE FIRST INTERNATIONAL SEAWEED SYMPOSIUM—*Held in Edinburgh, July 14–17, 1952.*

Institute of Seaweed Research, Inveresk, Midlothian. 10s. 6d. (paper). viii + 129 pp. + 2 maps; ill. 1953.

The contents include: abstracts of papers and discussion of phycology; algal chemistry; utilization; seaweed harvesting technology; and world seaweed resources; list of contributors and participants. Considering the potentialities, knowledge of the world's seaweed resources is very limited.

ECOLOGICAL CROP GEOGRAPHY AND FIELD PRACTICES OF THE RYUKYU ISLANDS, NATURAL VEGETATION OF THE RYUKYUS, AND AGRO-CLIMATIC ANALOGUES IN THE NORTHERN HEMISPHERE.

By M. Y. Nuttonson. American Institute of Crop Ecology, Washington, D. C. $4.00 (paper). 106 pp. + folding chart. ill. 1952.

GENERAL AND SYSTEMATIC ZOOLOGY

EINFÜHRUNG IN DIE ZOOLOGIE. *Band I. Zellenlehre, Stoffwechsel, und Energiewechsel. (Funktionelle Anatomie und vergleichende Physiologie der nichtreproduktiven Organe.) Band 2. Formwechsel, Abstammungslehre, und das System der Tiere.*

By G. von Studnitz. H. Bouvier & Co. Verlag, Bonn. (Vol. 1) DM. 15.80 (cloth); DM. 13.00 (paper). (Vol. 2) DM. 12.00 (cloth). (1) xxxiv + 174 pp.; ill. (2) iv + 127 pp.; ill. 1950; 1953.

Probably the output of college textbooks of biology and zoology is as voluminous abroad as at home. The present is a standard textbook of elementary zoology, divided, unnecessarily, into two thin volumes, which, mysteriously, do not divide the subject logically. The plan of the work evades the principles-phylogenetic series dilemma by presenting both aspects. Following a brief introduction on the cell, the various functions and the structures that mediate them are taken up in order, with the reproductive function running over into Volume II. Mitosis, heredity, and embryology find place in the part on reproduction. The remainder of Volume II ascends the animal scale with very brief considerations of each group. The coelomate Bilateria are divided into two phyla, Protostomia and Deuterostomia. There is a terminal short consideration of evolution. The text is clearly and simply written and can be recommended to zoology students for practice in the reading of zoological German.

L. H. HYMAN

GUIDE TO THE LITERATURE OF THE ZOOLOGICAL SCIENCES. *Revised Edition.*

By Roger C. Smith. Burgess Publishing Company, Minneapolis. $2.50 (paper). viii + 133 pp. 1952.

This invaluable guide, the only one of its sort, deals with the literature problems of the scientist, the mechanics of library and book classifications, bibliographies of the zoological sciences, abstract journals, and taxonomic indexes and literature. There are also chapters on the proper form for bibliographies, the various forms of scientific literature, and the preparation of scientific papers. For the young graduate student, with little experience regarding where or how to look things up, nothing could be more helpful. The experienced worker, too, is likely to discover the existence of a considerable number of aids unknown to him.

BENTLEY GLASS

ORGANISME ET SEXUALITÉ. *2nd Edition.*

By M. Caullery. G. Doin & Co., Paris. 2,300 fr. (paper). 489 pp.; ill. 1951.

The original edition of this chef d'oeuvre of one of the greatest of the elder generation of French biologists appeared in wartime (1941) and was largely overlooked by English-speaking biologists. The revision has been relatively minor, except for references to the newer work and the inclusion of some discussion of sexuality in unicellular organisms and in plants. For the most part, the author has limited himself to the Metazoa, and within this sphere it would indeed be hard to find another work that treats the subject so comprehensively and so authoritatively. The bibliography refers to 793 sources. Both Author and Subject Indexes are supplied.

BENTLEY GLASS

ACANTHOCEPHALA OF NORTH AMERICAN MAMMALS. *Ill. biol. Monogr., Vol. XXIII, Nos. 1–2.*

By Harley J. Van Cleave. The University of Illinois Press, Urbana. $5.00 (cloth); $4.00 (paper). x + 180 pp.; ill. 1953.

The late Harley Van Cleave devoted his research almost wholly to the study of the Acanthocephala, and the present monograph attests worthily the value of that research. It is the first, and tragically the last, of a projected series of monographs on the Acanthocephala of North America. The monograph covers briefly acanthocephalan morphology, especially those aspects of taxonomic value, and presents the scheme of classification devised by Van Cleave in 1948, according to which there are 2 classes and 4 orders in the Acanthocephala. The table of characteristics copied from the 1948 article shows all too clearly that the only difference

between two of the orders is the presence or absence of trunk spines. It is clear enough that the classes cannot be maintained on the basis of the differences presented and that one of the orders is superfluous. An arrangement into 3 orders is more sensible. Especial attention is devoted to the genus *Corynosoma* in North American mammals, but Van Cleave has never corrected the incomprehensible mistake into which he fell about *Corynosoma* in an earlier article where Saefftigen's pouch and the channels leading from it into the bursa were identified as the cement reservoir and cement ducts. *Corynosoma* does not, of course, have a cement reservoir. An interesting chapter on faunistic relationships indicates a general lack of distinctive species of Acanthocephala in North American mammals. The monograph closes with a useful check list of the North American mammalian hosts of Acanthocephala arranged by families and orders.

L. H. HYMAN

COMMON MARINE BIVALVES OF CALIFORNIA. *Fish Bull., Sacramento, No. 90.*

By John E. Fitch. State of California Department of Fish and Game, Marine Fisheries Branch, San Pedro. Free upon request (paper). 102 + iv pp. + 1 pl.; text ill. 1953.

The author of this work tells us in his preface that he had three ends in view in offering this work to the public: to standardize the popular names of the more common species, to integrate our knowledge of the economy of the clams, and to provide a ready means of identification of those species most likely to be encountered by those who exploit these organisms commercially. In the first of these aims he has been only partially successful, but his achievement in the pursuit of the other two should satisfy the most captious critic.

The attempt to supply common names to every recognized variety is of course futile. I once tried it myself and admit the mistake. Yet it would be helpful if every common species had a common name, if these names were standardized, and no name was used for more than one genus. The transferral of the name Washington Clam from the genus *Schizothaerus*, for which it has been used in molluscan literature for over half a century, to the genus *Saxidomus* which is in a different family is thus not to be commended. The term Bean Clam is here applied to *Donax gouldi*, which is commonly known as the wedge-shell—an unfortunate change, since this species does not look like a bean, while there are several other bivalves which do. The name Little Neck Clam has long been in use to designate *Venus mercenaria* of the Atlantic coast. If its scope is to be broadened to include other species as well, it should be restricted to closely related forms and should not have been used for *Protothaca*, which is not a subgenus of *Venus*, but of *Venerupis*.

The economy of the bivalves is well treated. Outside of their nutritional value those of California have but little commercial importance. There are no pearl fisheries in California (Lower California is excluded from this treatise) and the shells are not used for surfacing roads as they used to be in the Eastern states, nor are they burned as a source of lime, as was formerly the case. (One historian tells us that lime-burning was formerly the chief industry of California, and even goes so far as to derive the name from "horno de cal," meaning lime-kiln.) The author has, however, incorporated into this work a rather complete treatise on the growth and development, alimentation, breeding habits, and life in general of bivalve mollusca, and of course, a discussion of dinoflagellate poisoning.

In his attempt to supply a means for the ready identification of species the author has been eminently successful. The numerous photographs are among the best I have ever seen, and the photographer merits congratulation on the excellence of his work.

JOSHUA L. BAILY, JR.

THE MOLLUSCA OF KRUSADAI ISLAND (IN THE GULF OF MANAAR). *I. Amphineura and Gastropoda. Bull. Madras Govt. Mus., n. s., Nat. Hist. Sect., Vol. I, No. 2, Part 6. 1952.*

By S. Thomas Satyamurti; edited by the Superintendent. The Superintendent, Government Press, Madras. 10 Rp. 12 As. (paper). viii + 267 pp. + 34 pl. 1952.

This work is a faunal list which appears to be exhaustive. For each species there is a table of synonyms with bibliographic references, and an extensive commentary. There are 34 plates of line drawings carefully prepared and quite adequate for purposes of identification. The index consists of 7 pages, 3 columns to a page. The most striking feature of this insular fauna is the large number of nudibranchs and the absence of any freshwater gastropoda.

JOSHUA L. BAILY, JR.

SUBERITES DOMUNCULA (OLIVI): ITS SYNONYMY, DISTRIBUTION, AND ECOLOGY. NOTES ON ASTEROIDS IN THE BRITISH MUSEUM (NATURAL HISTORY), III AND IV. SOME INTER-TIDAL MITES FROM SOUTH-WEST ENGLAND. *Bull. Brit. Mus. (nat. Hist.), Zool., Vol. I, No. 12.*

By M. Burton, A. M. Clark, G. O. Evans, and E. Browning. The British Museum (Natural History), London. £1 (paper). Pp. 351–422 + 8 pl.; text ill. 1953.

The synonymy of the sponge *Suberites domuncula* is exceedingly confused, and an annotated list of names

that have been applied to it covers 10 pages of this article. *Suberites domuncula* is identical with *Ficulina ficus*. The whole taxonomic history of this confusion under two principal names is given. The sponge lives at depths from low tide mark to 1,331 meters, although mostly above 90 meters, generally on sandy or muddy bottoms, throughout the Arctic Ocean, the north Atlantic, and the Pacific north of 35° N latitude.

The second paper in this number of the bulletin is a valuable taxonomic discussion of the sea-star genera *Luidia*, *Tosia*, and *Pentagonaster*, based on material in the British Museum. The accompanying photographs are usually clear.

The mites of the intertidal zone comprise two ecological types, terrestrial species and those restricted to the intertidal zone. As the latter show no respiratory modification, it is presumable that they live in crevices containing imprisoned air during high tides. The legs, however, show modifications for a semi-aquatic life. The article consists mainly of taxonomic descriptions.

L. H. HYMAN

OBSERVATIONS ON THE LIFE HISTORY AND SENSORY BEHAVIOR OF THE SNAKE MITE, OPHIONYSSUS NATRICIS (GERVAIS) (ACARINA: MACRONYSSIDAE). *Spec. Pub. No. 10.*

By Joseph H. Camin. The Chicago Academy of Sciences, Chicago. $1.50 (paper). 75 pp. + 3 pl.; text ill. 1953.

A REVISION OF THE COHORT TRACHYTINA TRÄGÅRDH, 1938, WITH THE DESCRIPTION OF DYSCRITASPIS WHARTONI, A NEW GENUS AND SPECIES OF POLYASPID MITE FROM TREE HOLES. *Bull. Chicago Acad. Sci. Vol. 9, No. 17.*

By Joseph H. Camin. Chicago Academy of Sciences, Chicago. $1.00 (paper). Pp. 335–385; ill. 1953.

THE TROMBICULID MITES OF JAPAN. *Calif. Acad. Sci., Vol. XXVIII, No. 5.*

By Manabu Sasa and E. W. Jameson, Jr. California Academy of Sciences, San Francisco. $1.75 (paper). Pp. 247–321; ill. 1954.

TICKS (IXODOIDEA) OF THE MALAGASY FAUNAL REGION (EXCEPTING THE SEYCHELLES). *Their Origins and Host-Relationships; with Descriptions of Five New Haemaphysalis Species. Bull. Mus. comp. Zool. Harv., Vol. 111, No. 2.*

By Harry Hoogstraal. Museum of Comparative Zoölogy, Harvard College, Cambridge. $1.25 (paper). Pp. 38–113; ill. 1953.

These four studies on members of the Acarina cover some 277 pages and are indicative of the relatively recent recognition of the Acarina as interesting and extremely important components of the fauna of most habitats. Their significance became apparent only after the more obvious insect marauders were brought under control.

Camin's paper on the snake mite, *Ophionyssus natricis* (Gervais), is one of a relatively few extensive accounts of the life history and behavior of a mite. Each stage: egg, larva, protonymph, deutonymph, male and female, is described. Parthenogenesis produced only males. Females that had copulated laid eggs that produced both males and females, but it was not determined whether or not the eggs that produced these males were fertilized. All stages of the mite lived at times in dark, moist crevices. Only the protonymphs and adults visit the host to feed, where they locate themselves beneath the scales. Captive snakes are regularly found infested with this mite in zoos all over the world. The mite has the habits of a nest dweller. The host of the mite in nature is unknown. It is suggested that large tropical snakes, under their large scales, may provide the moist crevices frequented by the non-feeding stages. This mite is similar in behavior to a number of closely related forms. The most significant finding was the discovery of a pair of photoreceptors on the fleshy empodia of tarsi one.

The other three papers are sound contributions to the systematics of the Acarina. Camin's revision of the Trachytina was made possible and necessary by a comparative study of a number of species contained in the group. As revised, the cohort Trachytina is a well-knit group composed of two families and six genera. The genus *Dyscritaspis* Camin, 1953, is new. Sasa and Jameson have figured and redescribed 44 previously named species from Japan and have described one new species, *Trombicula koomori* Sasa and Jameson, 1954. The work is characterized by accurate observation, excellent illustrations, clear descriptions, and workable keys to all of the species. The report of Hoogstraal on Malagasy ticks has contributed much valuable new information. Five new endemic species are described: *Haemaphysalis tiptoni* Hoogstraal, 1953; *H. subelongata* Hoogstraal, 1953; *H. theilerae* Hoogstraal, 1953; *H. fossae* Hoogstraal, 1953; and *H. lemuris* Hoogstraal, 1953. The endemic tick fauna is composed of 9 species of *Haemaphysalis* and 1 of *Ixodes*. Seven species are considered to have Asiatic affinities and 2 African. The non-endemic species brought to the island by the activities of man are "entirely or almost entirely of African origin."

G. W. WHARTON

A MANUAL OF THE CHIGGERS. *The Biology, Classification, Distribution, and Importance to Man of the Larvae of the Family Trombiculidae. Mem. entom. Soc. Wash., No. 4.*

By G. W. Wharton; aided by H. S. Fuller. Entomological Society of Washington, U. S. National Museum, Washington. $6.00. vi +185 pp.; ill. 1952.

The introductory portion presents the chigger as a vector of human disease organisms and the problem of dermatitis or trombidiosis caused by chigger attach-

ment. A short discussion of chigger control is followed by a description of the behavior and the life cycles and biologies of chiggers. A discussion of the classification of the group follows a well illustrated portion upon the anatomy. Keys are furnished for the identification of chiggers to subfamilies, genera, and subgenera. A complete list of species is arranged according to genera together with the geographical location of the type, synonomy, occurrence, distribution, and host animals of species when known. A short discussion of general distribution and collecting methods is followed by a faunal list of species, and this in turn by a complete host list. Seasonal and ecological distributions are also discussed. There is an excellent bibliography and a good subject index. This will be an indispensable manual for all who are working with chiggers, and a valuable reference work and guide.

DWIGHT M. DELONG

CLASSIFICATION OF INSECTS. *Keys to the Living and Extinct Families of Insects, and to the Living Families of Other Terrestrial Arthropods. Bull. Mus. comp. Zool. Harv., Vol. 108.*

By Charles T. Brues, A. L. Melander, and Frank M. Carpenter. Museum of Comparative Zoölogy at Harvard College, Cambridge. $9.00 (paper). vi + 918 pp.; ill. 1954.

For nearly a quarter of a century the *Classification of Insects* by Brues and Melander has held a high position in entomological literature. It has now become time for someone to bring it up to date by incorporating in a new edition the more important discoveries of these last years. This has been done in a very able manner by Frank M. Carpenter, and the revised work has now appeared.

As the original edition is well known, it seems best to compare the new edition with the old. The 1954 volume contains 917 pages, about half again as many as the 1932 work. This increase in content is partly due to the inclusion of an entirely new series of chapters dealing with the extinct orders and families of insects. Most of the bibliographies which accompany the treatments of the several orders have also been more than doubled in size, an expansion reflecting the considerable amount of work which has been accomplished lately. This is especially to be noticed in the order Diptera, where the list of references has been increased from 27 to 124 pages.

The number of orders of insects recognized by Carpenter has been reduced from 34 to 27. The Pentastomida, treated as a class in the first edition, has been reduced to ordinal status. The key to the orders of insects has been rewritten, the changes occurring mostly in connection with the neuropteroid group. The keys to the families (and in some cases subfamilies) of the following orders have been rewritten and enlarged—Protura, Thysanura, Collembola, Odonata (adults only), Plecoptera, Embiodea, Trichoptera (key to pupae added), Siphonaptera, Coleoptera (key to larvae added). Keys to families of the arachnoid orders have also been somewhat extended.

The illustrations are the same in both editions, except that the numerous discrepancies between figure numbers and explanatory legends have been corrected. Many changes in name, made necessary by the application of the International Code of Zoological Nomenclature, have been made in the past 22 years; these have been incorporated in the keys.

There are apparently very few typographical errors and the type-face is one that is easily read. The changes that have been made are, on the whole, on the conservative side. The volume will certainly prove even more useful than its predecessor.

EDWARD A. CHAPIN

ENTOMOLOGICAL NOMENCLATURE AND LITERATURE. *3rd Edition, revised and enlarged.*

By W. J. Chamberlin. Wm. C. Brown Company, Dubuque. $3.50 (paper). viii + 142 pp. 1952.

The third edition of W. J. Chamberlin's reference manual for students of courses that deal with, or touch upon, the subjects of nomenclature and publications in entomology should prove of great value to the beginner, and also to the professional worker who needs a "refresher course." The pamphlet is divided into three parts: Entomological Nomenclature; Entomological Literature; and Scientific Publications. The first part deals with the history of taxonomy, species descriptions good and bad, the different types of keys and their construction, and the Rules of Zoological Nomenclature, with digests of the various Opinions which deal directly with entomology. Part Two treats of bibliographies and how to prepare them for publication, and supplies a list of the more important sources of bibliographic information. The third and last part discusses the preparation of papers for publication. If the information in this last part is studied and followed, there will be fewer trivial papers published, and our editors will be plagued with fewer badly prepared manuscripts.

One feels forced to remark on the comparatively large number of misspelled proper names in the second part of the work. It was to be hoped that page and volume numbers, when given, would have been more accurately transcribed.

EDWARD A. CHAPIN

THE GRASSHOPPERS AND LOCUSTS (ACRIDOIDEA) OF AUSTRALIA. *Volume II. Family Acrididae (Subfamily Pyrgomorphinae).*

By James A. G. Rehn. Commonwealth Scientific and

Industrial Research Organization, Australia. £2. 0s. 0d. 270 pp. + 32 pl. 1953.

The general scope of this work has already been described (*Q.R.B.*, 28: 184. 1953) so that it is only necessary here to note some of the main features of the second volume. The Pyrgomorphinae are a somewhat aberrant subfamily of the true grasshoppers (Acrididae). The group is undoubtedly an ancient one, whose main evolution has taken place in Africa and southern Asia (including the islands of Madagascar, Indonesia, and New Guinea). A few genera of pyrgomorphine grasshoppers occur in central America and Mexico, but none are found in the United States. According to the present revision, 4 tribes of the subfamily are represented in Australia. Of these, the Atractomorphini and Desmopterini (each with 2 representatives) are clearly Papuan in origin and probably reached tropical Queensland over a Torres Straits land bridge fairly recently (possibly in Pleistocene times). The status of these two tribes in the Australian fauna is paralleled by such dominant and widespread grasshoppers as *Acrida conica*, *Gastrimargus musicus*, and *Heteropternis obscurella*. In each of these cases we find a large African-Asiatic genus represented in Australia by a single species which inhabits the higher rainfall areas, where it is rather obviously a recent arrival that has not yet undergone any extensive adaptive radiation.

The situation with regard to the other 2 tribes of Australian Pyrgomorphinae is quite different. The genera *Petasida*, *Scutillya*, *Greyacris*, and *Monistria* are regarded by Rehn as sufficiently closely related to the dominant Afro-Indian genus *Poekilocerus* to be considered as members of the same tribe. But these 4 genera, with a total of about 27 described species, are clearly the result of a considerable adaptive radiation in Australia, *Monistria* being found in almost all the main regions and in a great variety of habitats. These genera are consequently "old Australians" which reached the continent at a much more remote period than the others we have mentioned, and not necessarily from the Papuan region.

The Psednurini are an endemic Australian group of very slender, elongated Pyrgomorphinae which recall certain members of other subfamilies such as the North American genera *Achurum*, *Prorocorypha*, *Eremiacris*, and *Parapomala*. They occur in the "heathy" areas around the eastern, southern, and western coasts of Australia, where they live among the strange flora of banksias, grevilleas, and xanthorrhoeas. The mouth parts in the 2 genera here recognized are very strongly modified, presumably in connection with specialized dietary habits. The relationships of this peculiar group to the other Pyrgomorphinae are quite unknown.

As in the previous volume, the author has found it necessary to revise radically the earlier work of the Swedish orthopterist Sjöstedt, 13 of whose species of Australian Pyrgomorphinae have been shown to be synonyms. Although future collecting will undoubtedly reveal additional species in the more remote areas of northern, central, and western Australia, Rehn's detailed and beautifully illustrated monograph represents an important stage in our understanding of the systematics and distribution of this group of insects. All those working with the Orthoptera will look forward with interest to the publication of future volumes in this series.

M. J. D. White

The Reproduction of Cockroaches. *Smithson. misc. Coll., Vol. 122, No. 12 (Pub. 4148).*

By Louis M. Roth and Edwin R. Willis. Smithsonian Institution, Washington. 80 cents (paper). 48 pp. + 12 pl. 1954.

The Mayflies or Ephemeroptera of Illinois. *Bull. Ill. nat. Hist. Surv., Vol. 26, Art. 1.*

By R. D. Burks. Illinois National History Survey, Urbana. $1.25 (paper). 216 pp.; ill. 1953.

The Mayflies of Florida. *Univ. Florida Stud., biol. Sci. Ser., Vol. IV, No. 4.*

By Lewis Berner. University of Florida Press, Gainesville. $5.50 (paper). xii + 267 pp.; ill. 1950.

These books are the records of years of field and laboratory study of mayflies. They include descriptions of structure, discussions of classification, and references to other contributions. They are permeated with an ecological point of view that makes the accounts lively and essential. I found them exciting.

The main subjects of the books are similar: a consideration of other studies of mayflies, their life history, ecology, classification with keys and descri‍tions, discussions of species native to the state, illustrations, and literature cited. These subjects are here reviewed briefly for each state.

Illinois. The pioneer American work on mayflies was done by Benjamin D. Walsh, who amassed a large collection of them from near his home at Rock Island, Illinois. By 1862 he had classified them and published descriptions of 26 species, of which he believed 13 were newly discovered. This was the beginning of mayfly history in the United States. In Burks's bulletin a detailed discussion of Walsh's collections and publications follows a brief survey of selected works on mayflies. He gives special approval of the systematic account of North American mayflies by Jay R. Traver in *The Biology of Mayflies* (Needham, Traver, and Hsu, 1935).

Everyone acquainted with the group knows a mayfly's life history. Yet it is so unique that it should be repeated as background of everything which follows. The stages are: the nymph; the winged subadult, almost

mature; and the completely mature adult or imago. The egg hatches in fresh or rarely in brackish water, and the nymph lives there very nearly throughout its lifetime. It eventually sheds the nymphal skin and emerges into the air, a subadult. More or less quickly it molts again and enters its short adult life. The winged subadult stage is unique among insects. Neither subadult nor adult takes any food.

The lifetime of a species of *Callibaetis*, egg to adult in 5 or 6 weeks, is held to be the shortest known. This observation is not new. In *Callibaetis fluctuans* there may be several generations in the relatively short spring and summer of a temperate climate. In the first discussion of life histories, the statement that "*Ephoron* and *Tortopus* do not have functional legs in the adults" is misleading, since the males do have well developed front legs which function in mating and probably as steering gear in flight. Indeed, the restriction of reduction to the middle and hind legs and to males only is mentioned later. The shift in function of the front legs of male mayflies from support to accessories of mating is a trend so general that it merits special mention.

Extensive observations are evident in the notes on the seemingly sudden emergence of large numbers of mayflies from the water. In Illinois, subadults of *Callibaetis* emerge from April to October, with a peak in late May and through June; *Ephemera* bursts from the large lakes in early June; and *Hexagenia bilineata* in late July. Shifts in reactions to environments occur in this time of complex activity, about which too little is known. A decided contrast in the timing of the emergence of mayflies of Illinois and Florida is apparent in the accounts in these papers.

The mating swarm-flight is the event next in time and importance to emergence. There is no feeding before or after it by mayflies of either sex. The content of the swarms, the places, times, and manner of the flights are described. The consequences to the fishes might also have been mentioned, since the flights usually occur above water and mayflies are an important food for several freshwater fishes.

There is a brief treatment of the external morphology, eyes of the two sexes, and wing venation. Directions are given for rearing and preserving mayflies. The compliments paid to dried specimens seem undeserved by their commonly fragile condition. To repair the mummified specimens that are found in some collections, Burks suggests immersion in trisodium phosphate.

Habitats of the nymphs are divided into 12 different types, and the remark is made that bodies of fresh water could be classified by the habitats of mayflies. In general, the nymphs are herbivores, but there are certain exceptions. *Metretурus pecatonica* is offered as a carnivore upon the evidence of the long teeth on its mandibles. Analysis of the food in the stomachs of a few nymphs would yield the facts.

The bulk of this report is devoted to a classification and descriptions of the mayflies found in Illinois. Keys to families are based on adults and on mature nymphs; to subfamilies, on adults and on mature nymphs; to species, on adult males and on mature nymphs and, in some cases, on adult males with separate keys for adult females. Ten families are represented according to the classification used. One more family is represented only by nymphs. Morphological characters and bases of classification are given freely, but the ecology is not neglected. Throughout this paper the illustrations are abundant and excellent.

Florida. The habits, numbers, and distribution of mayflies are different in Illinois and Florida; so is the history of their study.

Papers dealing specifically with Florida mayflies have been relatively few, and up to 1950, except for one (Berner, 1941), they were purely descriptions of a few species. The largest contributions were from Berner himself, 9 in 1940, 9 more in 1946, and 24 in 1950. Yet, in spite of the lack of early contributions, Berner can remark that one of the most beautifully written descriptions of the life and mating of mayflies is by William Bartram in the *Travels* (1791), in regard to mayflies on the St. Johns River in Florida. The preparation of the present report, *The Mayflies of Florida* (1950), and its pioneer character are most effectively described by the author:

"The present investigation was begun in 1937 after it was learned that almost nothing was known of Mayflies in Florida. . . . The real task soon became clear—it would consist of several phases, chiefly identifying those species of Ephemeroptera occurring in Florida, mapping their distribution, studying their ecology and habits and learning as much as possible of their life histories. In all, seven years were devoted to this endeavor in the course of which nearly all of Florida was covered, about fifty thousand specimens were collected and examined, numerous species of mayflies were reared, and much ecological information was obtained."

Only a few of the ecological subjects in the report may be mentioned here. The mayfly fauna of Florida is sparse in number of species compared with that of the north. The maximum number of species found in one Florida stream is 19, contrasted with 55 species taken from a stream in Ontario. Certain mayflies of Florida show origins from the fauna still farther south. *Campsurus* is an exception; although this is a predominant genus in South America, it is as yet little known in Florida. In contrast to the mayflies of northern climates, those of Florida tend to emerge from the water throughout the year, not as in the north, in great numbers at a few times. In Florida nymphs are seldom confronted with conditions that are unfavorable for transformation. The adults of almost all Florida species can be collected in every month except September, and this means a steady if not a superabundant food supply for fishes. Ten pages are devoted to descriptions of habitats, intermittent and permanent creeks, silt-bottomed with much or little vegetation, rivers that run over ledges of limestone, ponds, lakes, numerous

marshes and brackish backwaters, and a striking absence of rapid currents. In all this there is less reference to the mayfly inhabitants of these habitats than seems desirable. This lack is more than made up in the Annotated List of Mayflies.

A list of the species that have been found in Florida heads this taxonomic section. The species are classified into the families Ephemeridae, Heptageniidae, and Baetidae, with one or more subfamilies in each family. There is a key to the adult mayflies of Florida and another to the nymphs. Nineteen maps show the distribution of selected species in the state. There are drawings of structures relevant to classification and 24 full-plate portraits of various nymphs and adults. They show excellent detail and portray an unusual degree of their natural stance and beauty. The treatment of each species includes sections on taxonomy, distribution, seasonal life, and a list of locality records. These words do not confer the slightest impression of the vitality and significance which Berner has preserved in these accounts. They constitute some of the most stimulating material that I have recently found for further exploring mayflies.

ANN H. MORGAN

THE APHID GENUS PERIPHYLLUS. *A Systematic, Biological, and Ecological Study.*

By E. O. Essig and Frieda Abernathy. University of California Press, Berkeley and Los Angeles. $3.00. x + 166 pp.; ill. 1952.

This volume presents the results of several years' intensive and meticulous study of 10 species of aphids belonging to the genus *Periphyllus*. The introductory chapter presents a discussion of the genus, its origin, distinguishing characteristics, the historic background of the species placed in it, their world distribution, plant hosts, and their various body forms, with the variability of accompanying structures.

After this general discussion there are 10 chapters, in each of which one of the following species is treated in the following sequence: The sycamore maple aphid, *P. aceris* (Koch); the American maple aphid, *P. americanus* (Baker); the Colorado maple aphid, *P. brevispinosus* (Gillette & Baker); the California maple aphid, *P. californiensis* (Shinji); the Formosa maple aphid, *P. formosanus*; the Koelreuteria aphid, *P. koelreuteriae* (Takahashi); the Japanese maple aphid, *P. kuwanaii* (Takahashi); the Norway maple aphid, *P. lyropictus* (Kessler); the box-elder aphid, *P. negundinis* (Thomas); and the European maple aphid, *P. testudinacea* (Fernie). In each case the synonymy of the species, a description of its various stages and forms, its life history, and the host plants upon which it lives are presented, together with data regarding its occurrence in various world collections.

Three species, *P. californiensis*, *P. negundinis*, and *P. testudinacea*, were studied in detail as to their biology and anatomical characters. The author has shown that within a species as many as 15 unusual types of individuals may occur, one of which, a dimorphic stage in the young of the fundatrigeniae in April and May, continues in the first instar as a tiny disklike individual appressed to the leaf surface through the hot summers, and resumes its development in September and October.

Many apparent specific but complex forms are often difficult to distinguish or separate from closely related species by morphological characters. A study of their biology, life cycle, and ecology is often of great assistance in determining their specific status as biological forms, and is a valuable contribution to our knowledge of this group.

A complete bibliography of some 275 references is furnished. This monographic paper is an excellent example of a thorough, intensive study of a few species of closely related insects wherein all phases of their biology, behavior, and structures are combined in a single work.

DWIGHT M. DELONG

ATLAS OF THE SCALE INSECTS OF NORTH AMERICA. *Volume VI. The Pseudococcidae (Part II).*

By G. F. Ferris. Stanford University Press, Stanford; Geoffrey Cumberlege, Oxford University Press, London. $7.50. vii + pp. 279–506; ill. 1953.

Five volumes of this study have appeared previously. The preceding volume, Number V (*Q.R.B.*, 26: 404. 1951), contains the descriptions and treatment of about half of the named species of the Pseudococcidae. The purpose of this work is for the identification and recognition of the described species of this group. The original descriptions are in most cases inadequate for such work. Consequently, the author has redescribed each species by the use of diagnostic characters and has excellently illustrated each one by using enlarged line drawings of the entire insect and showing magnified portions of spines and other diagnostic structures. Some 34 genera and 103 species are treated. Keys are presented to all the genera and species which, according to the author, are not arranged on the basis of the classification but rather for simple, easy identification alone. This is an excellent piece of taxonomic work and should greatly facilitate the identification of species of the Pseudococcidae.

DWIGHT M. DELONG

THE SUCKING LICE. *Mem. Pacif. Cst ent. Soc., Vol. I. By G. F. Ferris; with the collaboration of Chester J. Stojanovich. The Pacific Coast Entomological Society, San Francisco.* $6.00. x + 320 pp.; ill. 1951.

The insect order Anoplura is treated in this volume,

and the author has attempted to summarize all previously existing knowledge on the systematics of this group of lice. A short introductory portion is concerned with the ectoparasites of birds and mammals. The morphology and anatomy of the Anoplura are discussed in detail and are excellently illustrated. A shorter discussion, also well illustrated, treats the subject of their growth and development. The taxonomic portion is preceded by a historical review. Keys are presented to families, subfamilies, genera, and species; and all these categories are discussed. Excellent detailed illustrations are used to exhibit the diagnostic characteristics of the generic types and also those species that occur on domestic animals. There is a special discussion of those species occurring on man and other Primates. One chapter is devoted to a complete list of mammalian hosts and another to the problems of geographical distribution. Two indices are given, one to the species of Anoplura and another to the species of mammalian hosts. This is an excellent summary and contribution to our knowledge of this important group of ectoparasites and will be of great assistance both to the teacher and the research worker. The excellent illustrations add greatly to its usefulness.

DWIGHT M. DELONG

AN ILLUSTRATED CATALOGUE OF THE ROTHSCHILD COLLECTION OF FLEAS (SIPHONAPTERA) IN THE BRITISH MUSEUM (NAT. HIST.). *Volume 1. Tungidae and Pulicidae. With keys and short descriptions for the identification of families, genera, species and subspecies.*

By G. H. E. Hopkins and Miriam Rothschild. British Museum of Natural History, London. £4. 4s. 0d. xv + 361 pp. + 46 pl., 1 folded map; text ill. 1953.

The preparation and publication of this large and well illustrated catalogue was made necessary by the deed of gift of a large collection of parasitic insects, mostly fleas, to the British Museum by Charles Rothschild. The three objectives which were established for this piece of work were to fulfil the deed of gift contract, to provide keys, descriptive notes, and figures to aid in the identification of the species included in this collection, and to publish the major portion of the skeleton classification prepared by Karl Jordon.

Some 1,000 species and subspecies, representing 239 genera, are treated with keys and short descriptions. The geographic range of each species is discussed on the basis of the material in the British Museum collection. Of the total number of species, 682 are represented by holotypes or lectotypes. This is the most important and the only comprehensive work which has been published on the fleas of the world. The book is adequately illustrated throughout the text and is supplemented by 45 plates of photographic illustrations.

DWIGHT M. DELONG

COLLECTING BUTTERFLIES AND MOTHS.

By Ian Harman. John de Graff, New York; Williams & Norgate, London. $1.95. 128 pp. + 7 pl.; text ill. No date.

This interesting little book deals with the techniques used by collectors of lepidoptera and is divided into chapters about equipment, setting, care of the collection, preserving larvae, rearing, collecting by day, collecting by night, varieties, collecting microlepidoptera, and the entomologist's calendar. Since it was written in Great Britain, it is of interest to compare the methods described with those used by North American collectors.

Attention is called to special collecting apparatus sold in England, but which apparently is not available in the United States. For example, the folding cane net includes a type which folds to pocket size. "Entomologists almost invariably use folding nets," states the author, "since few of them are bold enough to walk through the streets on the way to favourite collecting grounds carrying such a conspicuous object as a butterfly net."

Detailed instructions for rearing are given, together with methods for preparing display specimens of larvae. Inducing butterflies to mate and lay eggs in captivity is considered very difficult by most lepidopterists, but the author describes methods which he has found to be fruitful for at least some species. Various other interesting and unique methods include "sleeving," which is the term applied to the use of sausage-shaped bags of muslin slipped over the limbs of shrubs and trees, and in which caterpillars are enclosed under nearly natural conditions. To test the viability of a pupa, it is recommended that the insect should be touched with the tip of the tongue; if it feels cold it is living, whereas it is warm if dead. (I have not been personally inclined to try the efficacy of this technique.) In the chapters on the methods of collecting butterflies and moths one finds a number of suggestions of special interest. Among these is the exposure outdoors, in a cage, of a virgin female moth, with the expectancy of luring numbers of males. The author terms this "assembling," and characterizes it as "effective, though somewhat unsportsmanlike."

This book will be of interest to anyone who wishes to acquire a few more pointers in the rearing and collecting of butterflies and moths.

RALPH W. MACY

THE SPECIES OF THE GENUS HYDRIOMENA OCCURRING IN AMERICA NORTH OF MEXICO (GEOMETRIDAE, LARENTIINAE). *Bull. Amer. Mus. nat. Hist., Vol. 104, Art. 3.*

By James H. McDunnough. American Museum of Natural History, New York. $1.75 (paper). Pp. 237–358 + 3 pl.; text ill. 1954.

This monograph by one of the best-known specialists on lepidoptera treats of all of the species of the genus known to occur in North America as far south as the northern Mexican border. Entire collections of the groups were furnished for the study by leading museums and private collectors in the United States and elsewhere. Much greater stress is placed upon genitalia than has been true in former studies, which relied more upon palpal length and neglected the female genitalia.

A key to the 8 groups of the genus is followed by descriptions of the species and numerous races. It is of interest to note that McDunnough has named approximately half of the 55 species discussed, in addition to many races and forms, a number of which are described in this work. Most are illustrated on the halftone plates or are represented by drawings of genitalia, or both. The description of each moth includes notes on synonymy, distribution records, and other matters, including larval food plants when known. This bulletin supplies an important need of specialists in moths.

RALPH W. MACY

THE COLEOPTERA OF THE GALAPAGOS ISLANDS. *Occ. Pap. Calif. Acad. Sci., No. XXII.*

By Edwin C. Van Dyke. California Academy of Sciences, San Francisco. $3.50 (paper). 181 pp.; ill. 1953.

The faunas of remote island groups are of uncommon interest, if such islands have been isolated at least for the most recent geological periods. This appears to be the case for the Galapagos Islands, which lie in the Pacific on the equator about 600 miles from the west coast of South America.

The present monograph gives the result of a taxonomic study of all the known beetles of these islands. The author had at his disposal the material which a California Academy of Sciences expedition collected in 1905 and 1906 and which appeared to be much more extensive than that collected by any other group. Accordingly, a considerable number of new species is described in the volume. Besides this, Van Dyke had the opportunity to study the type material of previously described species so that the account might be authoritative and reliable. Numerous figures illustrate the text.

The beetle fauna of the Galapagos Islands is not very rich. Only about 200 species are known. This is due to the semi-arid climate, in which only those insects can survive which are well adapted to it. The beetle fauna is very similar to that of the semi-arid regions of the South American mainland. Closer study shows, however, that most species are distinct. This demonstrates the effect of long isolation upon a fauna which probably once came to the Islands from the mainland. The Tenebrionidae are particularly numerous, a fact which the Galapagos have in common with the arid parts of western America. In several families the size of the wings is reduced and the resulting loss of mobility has favored the breaking up into species and subspecies that are restricted to a single island.

Van Dyke sees, in the similarity of the Galapagos beetle fauna to that of Peru and Ecuador, evidence that the islands were once connected to the mainland and populated from there. Time and isolation then worked the transformation into distinct species which now occur only on the Galapagos Islands.

G. H. DIEKE

BEES OF PANAMÁ. *Bull. Amer. Mus. nat. Hist., Vol. 104, Art. 1.*

By Charles D. Michener. American Museum of Natural History, New York. $3.00 (paper). 176 pp.; ill. 1954.

This work will primarily interest and serve systematists and field naturalists, as it provides the first comprehensive list and review of the bees known to occur in Panama. There is a key to the 59 genera of bees represented in Panama, as well as occasional keys to species. Two new genera, 7 new subgenera, 42 new species, and 5 new subspecies are described, and 1 new name is provided. Collecting records are given for the 353 species listed, and the principal collecting localities are briefly characterized. A short discussion of certain biological topics (seasonal variation in the activity of tropical bees, oligolecty, and origin of the panamanian bee fauna) serves as introduction to this useful and impressive monograph.

KENNETH W. COOPER

ZOOLOGICAL RESULTS OF A FIFTH EXPEDITION TO EAST AFRICA. III. REPTILES FROM NYASALAND AND TETE. IV. AMPHIBIANS FROM NYASALAND AND TETE. *Bull. Mus. comp. Zool. Harv., Vol. 110, Nos. 3 and 4.*

By Arthur Loveridge. Museum of Comparative Zoölogy, Harvard College, Cambridge. (3) $2.35 (paper). (4) $1.25 (paper). (3) Pp. 143-322 + 5 pl. (4) Pp. 325-400 + 4 pl. 1953.

III. This report is concerned with the reptilian fauna of Nyasaland, which is now known to be comprised of 110 species. Except for a half-dozen kinds of turtle and one crocodile, the species included are about equally divided between snakes and lizards. Loveridge himself, during a recent ten-months' trip to the area, was able to collect over 85 per cent of the known fauna.

After some introductory material, the individual forms are treated systematically. There is a fair amount of nomenclatorial rearrangement, including the de-

scriptions of 11 new species and subspecies and a new genus. This rather heavy text is occasionally relieved, under one or another species account, by an interesting description of an animal's habits, by an amusing summary of some local folklore, or by an exciting story of a Loveridge adventure.

Besides a list of literature, there is an appendix which contains keys designed to assist in the recognition of Nyasaland reptiles. There are several plates.

IV. This report, which treats of one caecelian and 49 kinds of frogs, follows the same arrangement as the companion work on reptiles that is reviewed above. Seven forms of frogs are newly described.

ARNOLD B. GROBMAN

REPTILES AND AMPHIBIANS. *A Guide to Familiar American Species. A Golden Nature Guide.*

By Herbert S. Zim and Hobart M. Smith; illustrated by James Gordon Irving. Simon & Schuster, New York. $1.50. 157 pp.; ill. 1953.

The books in the Golden Nature Guide Series are so widely distributed wherever pocket books are sold, that it is scarcely necessary to describe their general arrangement. Zim and Smith, in describing within the space available the more interesting of the over 850 forms of reptiles and amphibians in the United States must have had a problem, largely, of what to omit and how to condense what was retained. For example, the salamander genus *Plethodon* contains 30 described forms, but the authors had to be content with a discussion of only the 2 most widely distributed species.

All in all, about a third of the known forms are described; their U. S. ranges are indicated on maps; and representatives are figured in color. Interesting but concise summaries of the forms, and a few pages of general statements, make up the book. The end-papers and covers are attractive. The graphic portrayals are excellent considering that this is an inexpensive mass-produced item. If any one group was not as well illustrated as others, it would seem to be the salamanders.

While this book is selective and does not attempt to provide keys for the identification of the species in the United States, I would guess that it would permit a novice to place ninety per cent of his collections quite accurately. I think it represents a good purchase and should prove to be a satisfactory first book for youngsters or adults with a developing interest in herpetology.

ARNOLD B. GROBMAN

THE POCKET GUIDE TO BIRDS. *Eastern and Central North American.*

By Allan D. Cruickshank; 72 natural color photographs by Helen G. Cruickshank; 78 drawings by Don Eckelberry. Pocket Books, New York. 50 cents (paper). 216 pp.; ill. 1954.

As a teacher of elementary ornithology I have experienced the same problem that Cruickshank did when he identified a red-breasted nuthatch and then proceeded to explain how it could be distinguished from a white-breasted nuthatch. One lady immediately said, "That is all very well, but to begin with, how do I know it is a nuthatch?" From such experiences this book was conceived. It is intended for the very beginner, the one who does not know a nuthatch from a woodpecker. The characteristic identifying features of each group of birds (usually by families) are pointed out, and other forms with which confusion might exist are carefully compared. The geographical scope of this guide comprises that area of Canada and the United States east of the Great Plains. Not all species of birds that occur within this area are included; the rare and the unusual have been omitted. There are 72 full-color photographs taken by the author's wife and originally published in the magazine *Woman's Day*, and 78 pen and ink line drawings by Don Eckelberry. By using this book first, the beginner will have learned enough to enable him to graduate to Peterson.

HENRI C. SEIBERT

SOUTHERN AFRICAN MAMMALS 1758 TO 1951: A RECLASSIFICATION.

By J. R. Ellerman, T. C. S. Morrison-Scott, and R. W. Hayman. British Museum (Natural History), London. £2. 0s. 0d. 363 pp. + 2 maps. 1953.

Although this book follows much the same pattern as Ellerman and Morrison-Scott's *Checklist of Palaearctic Mammals*, it is more appropriately called a "reclassification." As such, it is an interesting statement of the authors' opinions on the nomenclature and relationships of the mammals of southern Africa.

The scope of the work is broad. As a checklist it is an immensely useful, as well as thorough and scholarly, compilation of the names and original references for all the forms described from this area. Revisions have been carefully examined, and references to these usually include comments on their value. Distributions have been worked out as far as possible, though no maps are given. Keys to the various groups, as well as being helpful to those unfamiliar with African mammals, are of interest to the specialist in that they show the kinds of characters relied on in making this classification. In general the pattern has been to base the nomenclature on previously published investigations of the various groups. Where no such work has been done the authors sometimes attempt their own revisions as in the Chrysochloridae, sometimes give a "tentative classification" as in the *Crocidura*, and sometimes introduce new trinomial combinations with no discussion at all.

Taken as a whole the work reflects a characteristic

preoccupation with stability and simplification rather than with the details of and reasons for variation, and this point of view is further emphasized by the authors' advocacy of a return to the binomial system. Such a preoccupation seems a reaction against the oversplitting which often but not necessarily comes from detailed studies of variation. Unfortunately, a recognition that oversplitting destroys the usefulness of a taxonomy does not by itself suffice as a basis for reducing the number of recognized forms, and the present reclassification points up sharply the need for detailed generic studies as a basis for classification. Some of the genera included I have had occasion to investigate myself and know to be far more complicated than this rather simplified treatment leads the student to believe. In some instances the range given indicates that two races of a single species occur together in a given area; in others, races of clearly distinct species are made conspecific. This effectively masks the diverse character of such genera as, for instance, *Tatera* and *Leggada*. Further, the taxonomic philosophy as stated in the Introduction suggests a rather strong tendency to rely on indirect evidence and a partial examination of the material. This is borne out by the text where "in our opinion" or "it appears to us" is of far more frequent occurrence than references to an actual definitive study of all available material of a particular group.

The authors admit their treatment is uneven and point out in their Introduction that it is far simpler to describe a form than to relegate it to synonymy. This is an opinion to which I heartily subscribe. I would even go a step further and say that no useful purpose is served in proposing new combinations of names as is done here unless the evidence for such combinations is more thoroughly examined and presented in detail. To shift names around as a matter of opinion results only in new confusion, and the cause of stability is not served.

All of this makes the work less valuable as a reclassification than as a checklist. As an indication of a different approach to taxonomy it merits careful attention. The fault with the trinomial system lies not in the system but in its abuse, and we can well be influenced by our British colleagues' common-sense approach to the problem of too many subspecies. They in turn will perhaps come to value a more thorough examination of long series as forming the soundest basis for some much needed lumping.

BARBARA LAWRENCE

ECONOMIC ZOOLOGY

FIELD CROP INSECTS.
By F. A. Fenton. The Macmillan Company, New York. $5.75. x + 405 pp.; ill. 1952.

As the author states in his Preface, this book is especially designed for classroom use. After some introductory material upon insect abundance, distribution, biology and ecology, 6 chapters are devoted to the various types and methods of insect control. The remainder of the book, some 7 chapters, presents a series of specific insect problems which cause important losses to field crops. These insects are discussed with reference to the method of feeding, such as "sap sucking insects," or with reference to their mode of living, as "soil inhabiting insects" and similar groupings. This book is well illustrated and presents the field concisely but adequately for the beginner.

DWIGHT M. DELONG

FOREST LEPIDOPTERA OF SOUTHERN ONTARIO AND THEIR PARASITES *Received and Reared at the Ottawa Forest Insect Survey Laboratory from 1937 to 1948.*
By Henri Raizenne. Department of Agriculture, Division of Forest Biology, Ottawa. Free upon request (paper). vi + 278 pp. 1952.

This extensive report deals with some of the forest Lepidoptera of southern Ontario, their distribution, host trees, period of land and adult activity, degree of infestation, and parasites. It is based upon information gathered from Forest Insect Survey records at Ottawa during the years from 1937 through 1948 and represents the observations and work of many of the leading entomologists of Canada. The sequence of the 468 listed species is according to McDunnough's check list of *Lepidoptera of Canada and the U. S.*, utilizing catalogue numbers from that publication. This is the first of a series which, it is stated, will include even "more comprehensive and more elaborate statements" on forest entomology. The body of the publication is preceded by a brief foreword, introduction, and outline map of the region under consideration. Fourteen species of butterflies are included, followed by 454 species of moths. Among the parasites infesting these, the ubiquitous tachinid fly *Compsilura concinnata* is noted to infest many species, including both butterflies and moths. This compilation is of special interest to all forest entomologists, ecologists, and lepidopterists.

RALPH W. MACY

FISH-CULTURE IN INDONESIA. *Spec. Pub. No. 2.*
Edited by A. E. Hofstede, R. O. Ardiwinata, and F. Botke; General Editor: G. L. Kesteven. Indo-Pacific Fisheries Council, Bangkok. $1.50 (paper). xii + 129 pp. + 30 pl., 1 diagram, 6 maps; text ill. 1953.

The papers in this pamphlet were originally given at a symposium on brackish water fish-culture at Djakarta in 1951, and principally concern the culture of the milk fish (*Chanos chanos*) and carp in Indonesia, with

ecological data on some of the ponds. The illustrations include a series of well-reproduced plates of the important species of fish cultured in the ponds.

PROCEEDINGS OF THE 4TH MEETING, INDO-PACIFIC FISHERIES COUNCIL, AT QUEZON CITY, REPUBLIC OF THE PHILIPPINES. *23rd October–7th November, 1952. Section II.*

Indo-Pacific Fisheries Council, Bangkok. $1.50 (paper). Pp. 103–276; ill. 1953.

Seventeen papers, concerned with hydrology and plankton, marine fisheries, inland fisheries, technology and soci-economics, are printed in full in this number, and 23 papers are printed in summary or abstract form.

JOEL W. HEDGPETH

LENGTH COMPOSITION OF CALIFORNIA COMMERCIAL CATCH OF PILCHARD, 1919 TO 1951. *Spec. sci. Rep. U. S. Fish Wildl. Serv., Fisheries No. 105.*

By Margaret M. Calderwood. U. S. Department of the Interior, Fish and Wildlife Service, Washington. Free upon request (paper). 81 pp. 1953.

OUR WILDLIFE LEGACY.

By Durward L. Allen. Funk & Wagnalls Company, New York. $5.00. x + 422 pp. + 17 pl. 1954.

To the many millions of American tourists who explore our country each year, the sign "National Wildlife Refuge" has become familiar. For the fewer millions whose delight it is to fish and hunt, contact with federal and state rules is more intimate through licenses, duck stamps, and special taxes on equipment. Seldom does either group of persons realize how much study and experimentation lies behind the purchase of refuge land or the rules for the use of living natural resources in fish and game. The U. S. Fish and Wildlife Service, in the Department of Interior, cooperates with state agencies throughout the country in an attempt to provide the largest possible sustained yield of recreation and food from the streams and lakes, marshes and hedgerows, forests and deserts of our land. Only at rare intervals is it possible for a reader to consider in logical sequence the many facets of this vast public enterprise, to see what his tax dollars provide. This information-packed book affords such a view.

D. L. Allen is to be congratulated on his fast-reading survey of the past and present of our wildlife legacy, his masterful marshalling of examples and clear analyses of method and effect. Few biologists have had so extensive an opportunity to study the present full scope of wildlife management. Still fewer could retain perspective on so large a field, and relate so obviously the concepts and activities in America's pioneering past to the wasteful practices and misunderstandings that persist at present. Yet his analysis is no long-drawn moan. Rather, he states distinctly and in colloquial idiom the situation as he sees it, and considers the ways for future improvement. He is no Pollyanna, and his statements are supported by names and places, by 36 pages of reference notes and a 501-entry bibliography.

Conserving and building fertility has become the first step in managing all renewable resources, and there is perfect correlation between the fertility of a soil or a pond and the crops that it can produce—in grain, in pheasants, in cattle, in deer, in fish. To increase all of these is the important program, and such specialized management can be built into parallel benefits for farmer, forester, and grazier. In his book, Allen gives less space to farm crops, livestock output, forest yield, and commercial fisheries because these already have their loud-mouthed lobbies. Rather his eye is on "our public livestock"—the wildlife that has survived to the present. His concern over species on the way toward extinction may seem foolish to the calloused. His information regarding predators and his disgust for the bounty system may outrage some provincial ranchers. His ideas on the proper use of government fish hatcheries will have little appeal to those fishermen who find "sport" in dipping up legal-sized fish from behind the hatchery truck. His concern over adequate hunting to prevent deer from destroying their range, to keep them within its carrying capacity, will make the sentimentalists squirm—particularly those who fight to protect the does which combine motherhood with antlerless unsuitability as trophy heads. But every citizen owes it to himself to read the documented facts, to give Allen's gentle persuasion a chance, to see how vital it is that present actions provide our country with a future. Should a dam be built that blocks all future productivity of a great river system to a commercial fish such as salmon, without an adequate study of the problem and the inclusion of every foreseeable device to maintain the *status quo* or improve it? "Do we need to keep some country free of commercial clutter where there is half a chance of catching a big fish, seeing an eagle, or hearing a wolf howl? And should we have places, not too far from home, where, like Garbo, one can just be alone? If we want such things, we'd better get them now." The salmon, the eagle, and the wolf still alive are the ancestors of all the salmon and eagles and wolves the earth will ever have. "Their value must be calculated in terms of the crop for all time to come—in other words, it is incalculable."

LORUS J. & MARGERY J. MILNE

OPEN BOAT WHALING IN THE AZORES. *The History and Present Methods of a Relic Industry. 'Discovery' Rep., Vol. 26.*

By Robert Clarke. Cambridge University Press, New York. $4.25 (paper). Pp. 281–354 + 1 chart + 7 pl.; text ill. 1954.

The days of Moby Dick are not quite over, as this elaborate report on whaling in the Azores attests. The report, in a series devoted principally to Antarctic oceanography and biology, is a unit by itself and should interest economic geographers and others who are not in the habit of examining this series for material.

CATS. *Dover-Foyle Handbooks.*
By Kit Wilson and Addison Webb; with a selective bibliography by Cecil and Agatha Dubney Davis. Dover Publications, New York. $1.50 (cloth); 60 cents (paper). 106 pp. + 17 pl.; text ill. 1952.

This inexpensive, informally written guide to the care of cats also includes chapters on the history and structure of cats, as well as information on showing the various breeds. A listing of clubs of cat fanciers and an extensive bibliography are included. The text is enhanced by a well-chosen collection of drawings and photographs.

FRANK C. ERK

ANIMAL GROWTH AND DEVELOPMENT

LA DIFFÉRENCIATION DU SEXE ET L'INTERSEXUALITÉ CHEZ LES VERTÉBRÉS. *Facteurs héréditaires et hormones.*
By Kitty Ponse. F. Rouge & Cie, S. A., Librairie de l'Université, Lausanne. 52.00 S. fr. (paper). 367 pp.; ill. 1949.

Mlle. Professor Ponse has gathered together in this book the available information on sex determination in vertebrates. This subject is treated from two points of view, the hereditary or genetic, to which one-third of the book is devoted, and the external factors, with which the largest portion of the work is concerned. Not only does the author give a rather complete, if not encyclopedic review of the observations of many workers, but she has provided a personal interpretation that brings together the great mass of material, some of which is in apparent conflict.

Thus is seems that there is in each vertebrate a fundamental genetic bipotentiality of sex. In the gonad itself there seem to be areas specifically susceptible to the influence of feminizing or masculinizing inductors, which are the real basis of hereditary determination. On this gene-determined background various external factors operate. In the normal situation these will reinforce the genetic factors so as to produce a normal individual, but under experimental circumstances, or in experiments of nature, as with the crossed placental circulation producing the freemartin, the exterior factors will produce various states of intersexuality, depending on time of onset, intensity, etc. The hormones, both embryonic and adult, are by far the most important modifying influences; but such factors as temperature, hypermaturation, and grafts may also be important under experimental conditions.

Parts of this interpretation make it easy to understand the various forms of intersexuality met in the examining room, although little consideration is given to human material in Ponse's review. This omission is doubtless on purpose and probably wise, as human cases are much more difficult to understand than the animal, where many factors can be controlled. Nevertheless a review such as this is invaluable to the clinician as a background to the interpretation of those unfortunate individuals who have been the subject of one of nature's experiments. Furthermore, even most biologists concerned with these matters should find this complete review most rewarding. Although this book is now several years from writing, the author assured the reviewer, who recently visited her laboratory, that the work of the last few years has caused little alteration in the interpretations presented. The work is a classic in its field and will probably be without a peer for years to come.

HOWARD W. JONES, JR.

ANIMAL MORPHOLOGY

ANIMAL BIOCHROMES AND STRUCTURAL COLOURS. *Physical, Chemical, Distributional & Physiological Features of Coloured Bodies in the Animal World.*
By Denis L. Fox. Cambridge University Press, New York. $11.00. xiv + 380 pp. + 3 pl., 1 folded chart; text ill. 1953.

Animal Biochromes and Structural Colours is an extremely useful collection of information concerning the physiological and biochemical aspects of animal coloration. The area covered is immense, ranging from structural colors through the major classes of colored compounds found in animals. Emphasis is placed on the phyletic and anatomical distribution, chemical properties, and physiological significance of the pigments, and particularly upon analytical techniques, largely chromatographic and spectrophotometric. With its excellent bibliography, this book will undoubtedly serve as a valuable point of departure for investigators of animal coloration for many years. It is, in fact, the only modern treatment of these aspects of animal coloration.

This unique position makes it especially regrettable that the book is far from perfect. Aside from minor errors of fact, the failure to achieve perfection in this instance can probably be ascribed to lack of selectivity. The theme is extremely broad, facilitating digressions which could have been eliminated in favor of more pertinent material. This tendency to digress is illustrated by the discussion of the tetrapyrroles, which begins with a soundly constructed analysis of the coloring imparted by hemoglobin, wanders into the respiratory functions of these pigments, and finally leaves the reader faced with the tetrapyrrole situation in the root nodules of the soy-bean. Throughout the book the author is similarly undecided as to how far the discus-

sion of the physiological properties of the biochromes should be carried.

The definition of color in terms of the human visual spectrum serves to emphasize another of the difficulties with which the author has had to cope. From this definition it becomes obvious that the assemblage of colored compounds which concern the student of animal pigmentation is actually held together by the slimmest of relationships, namely, animal origins and the property of selectively absorbing light in a restricted region of the spectrum. Color has significance at the behavioral level but, photosynthetic substances excepted, it is a relatively unimportant property in a biochemical frame of reference. The animal pigments therefore comprise a group of substances completely unrelated both in structure and function. Considering this fact, it is not especially surprising that this monograph, divorced as it is from the behavioral and evolutionary aspects of animal color, takes on some of the qualities of a catalog. While this will not necessarily detract from the usefulness of the book to specialists, it is a formidable deterrent to the casual reader.

In 1944 the author proposed the term "biochrome" for colored substances of biological origin. He argued that the common properties of selective absorption of visible light and biological origin were sufficient reason to group them in a distinct biochemical class. In this book a companion term, "schemochrome," is proposed to describe that category of biological colors otherwise called structural. Over and above the point, already suggested, that color may possibly not be a sufficiently significant property to warrant the erection of a new biochemical category, it does seem certain on other grounds that the choice of terms for the subgroups of the new category is unfortunate. Etymologically, biochrome is inclusive of both types, structural and pigmentary, and its now-intended application only to pigments may be confusing.

J. F. CASE

VERTEBRATE DISSECTION.
By Warren F. Walker. W. B. Saunders Company, Philadelphia and London. $3.50. x + 332 pp.; ill. 1954.

This laboratory manual is planned to cover the anatomy of a few vertebrates rather thoroughly from a comparative and evolutionary viewpoint. The 3 introductory chapters concern The Lower Chordates, The Lamprey —A Primitive Vertebrate, and The Evolution and External Anatomy of Vertebrates. The 8 chapters that follow deal with the several organ systems, each chapter including a section on fishes, another on primitive tetrapods (*Necturus* and turtle), and a third on mammals, so arranged that either cat or rabbit may be used. The figures accompanying the text are not such as to substitute for the student's observation and dissection. The most excellent feature of the manual is its flexibility, inasmuch as the arrangement will permit the elimination of a sizable portion without involving a sacrifice of the comparative aspects or a loss of thoroughness in the study of each vertebrate type retained.

Three appendices provide helpful Terms for Directions, Planes, and Sections; directions for The Preparation of Specimens; and a list of References. There is a very full index.

A criticism may be directed at the typography, which is close and heavy in appearance. All directions for dissection are printed in boldface, with emphasized terms in full capitals, and the resulting effect is overpowering and very definitely wearying.

BENTLEY GLASS

LABORATORY ANATOMY OF THE FETAL PIG.
By Theron O. Odlaug; illustrated by Carl Petterson. Wm. C. Brown Company, Dubuque. $1.50 (paper). ii + 43 pp.; ill. 1951.

The fetal pig is gaining popularity for use in beginning biology courses and in some advanced courses. This spiral-bound manual covers the anatomy of the fetal pig adequately for all general purposes. Its value is greatly enhanced by Carl Petterson's drawings, which frequently show both the lateral and ventral views of a system.

FRANK C. ERK

DISSECTION GUIDES. IV. THE RABBIT.
By H. G. Q. Rowett. John Murray, London. 3s. 6d. (paper). 32 pp.; ill. 1952.

DISSECTION GUIDES. V. INVERTEBRATES.
By H. G. Q. Rowett. John Murray, London. 4s. (paper). 66 pp.; ill. 1953.

These laboratory manuals are models of clarity. The structure of each animal and the various steps in dissection are illustrated by beautifully lucid and fully labeled line drawings, often including an outline of scissors, scalpel, or fingers to indicate the precise way a specified cut or maneuver should be made. Beneath each figure is a brief series of directions given as simple sentences in one, two, three order. There is no text. It seems unnecessary.

The booklet on the rabbit includes 48 figures of the type just described. The guide on invertebrates contains 81 figures, more or less equally divided between the earthworm (with informative notations about the differences in external and internal anatomy found in the 7 commonest species), the crayfish, cockroach, amphioxus, mussel, and snail. Except for the musculature of the rabbit, which is largely omitted, a student who uses these guides will gain an exceptionally clear and complete knowledge of the gross anatomy of the animals dissected.

G. B. MOMENT

THE DISSECTION OF THE CAT (*and Comparisons with Man*). *A Laboratory Manual on Felis domestica. Second Edition.*

By Bruce M. Harrison. The C. V. Mosby Company, Company, St. Louis. $3.50 (paper). 209 pp.; ill. 1952.

The pages of this guide to the dissection of the cat are perforated for easy removal and are punched to fit standard notebooks. The instructions are clear, and stress the similar and contrasting anatomical features of the cat and the human being. The drawings are designed to be labeled by the student, but occasionally attempted realism in the drawings obscures essential anatomical relationships.

FRANK C. ERK

PRIMATES. *Comparative Anatomy and Taxonomy. I—Strepsirhini. A Monograph.*

By W. C. Osman Hill. Edinburgh University Press, Edinburgh; [Interscience Publishers, New York]. £5. 5s.; $15.75. xxiii + 798 pp. + 34 pl.; text ill. 1953.

Since the appearance of Elliott's sumptuous but monumentally useless 3-volume *Review of the Primates* in 1913, all students of primatology have prayed for a successor to bring order out of the chaos in which he left this important group of mammals. The present volume is Part 1 of the answer to their prayers, covering the lemurs and their relatives the lorises and galagos, living and extinct. Anyone with the hardihood to attack the Augean stables of the taxonomy of the primates is to be congratulated, whatever the merits or demerits of his work. Hill has met the problem of the endlessly tangled nomenclature of the primates by largely ignoring it, which may cause suffering among the nomenclaturists but is quite possibly the only practical solution to the problem. On the other hand, taxonomists may legitimately object to the uncalled-for liberties the author has taken with established taxonomic format, which detracts from the usefulness of the work and suggests that the author is not familiar with the true function of taxonomy. There are useful distribution maps of the subspecies of nearly all species, and photographs of most of the conspicuous species. A few of the photographs are excellent portraits of living animals, most are fair, and some are of very indifferently mounted specimens. There are keys to genera, species, and some (but not all) subspecies.

The bulk of the volume reflects Hill's interest, which is anatomy and behavior. I, at least, find this aspect of the work somewhat disappointing, and I fear comparative anatomists and physical anthropologists will find it less useful than might legitimately have been expected. The "external characters," especially the external genitalia and the dermatoglyphics of hands and feet, are described in detail and are well illustrated, but the remainder of the anatomy is treated rather sketchily and is inadequately illustrated. Some available data, such as brain weight, cranial capacity, and body weight, have been omitted entirely. Proportions and ratios of limbs and other parts are given in loose verbal form instead of in exact numerical terms. It cannot be determined whether measurements, where given, represent single measurements or the means of a series; at least an elementary statistical treatment of numerical data, which would occupy no more space than cruder forms of presentation, is not an unreasonable demand of modern biology.

There is a bibliography of 16 pages, unfortunately in the abominable form that omits titles, leaving the reader to find out for himself the nature and scope of each reference. This is deplorable in a work of this kind. The book is well indexed, although I find such surprising omissions as "food," "longevity," and "breeding habits."

D. DWIGHT DAVIS

THE MAMMARY GLAND. *I. The Anatomy of the Udder of Cattle and Domestic Animals.*

By Charles W. Turner. Lucas Brothers, Columbia, Mo. $10.00. xviii + 389 pp.; ill. 1952.

Although this is the first formal edition of *The Mammary Gland*, the material has been used as a text by Turner's graduate students since 1933. In the present volume the material has been divided into three general sections: the gross anatomy of the udder of cattle; the microscopic anatomy of the udder of cattle; and the anatomy of the mammary gland of the Ungulata and marine mammals.

The vascular, lymphatic, and nervous systems of the mammary gland are described in detail and illustrated by photographs and drawings. The section on the microscopic anatomy includes chapters on the cytology of the mammary gland and the process of milk secretion, and other chapters dealing with the histochemistry and enzyme systems involved in milk secretion. There is a separate chapter on the pathologic anatomy of the gland.

The material is up to date and on the whole concisely written and well documented with literature citations and quotations. The text is ideally suited for graduate instruction and could well serve as a reference work for undergraduate students in dairy and animal husbandry and for biologists interested in the comparative anatomy of the mammary gland.

FREDERICK N. ANDREWS

COMPARATIVE MORPHOLOGY OF THE BODY SKELETON IN RECENT CANIDAE. *Univ. Calif. Publ. Zool., Vol. 52, No. 5.*

By Milton Hildebrand. University of California Press, Berkeley and Los Angeles. $1.00 (paper). Pp. 399–470; ill. 1954.

ANIMAL PHYSIOLOGY

ADVENTURES IN PHYSIOLOGY *with Excursions into Autopharmacology.*

A selection from the scientific publications of Henry Hallett Dale; with an introduction and recent comments by the author. Pergamon Press, London; [The MacMillan Company, New York]. $19.50. xvi + 652 pp. + 1 pl.; text ill. 1953.

Little need be said concerning the contents of this volume, since it consists of 30 scientific papers and lectures selected by the author from the 253 original communications of his bibliography. This collection of papers is of great value in itself, but that value is enhanced by the brief discussion appended to each of the republished works. Here one gets a glimpse of the progress of physiological and pharmacological studies during the past half century. The introductory remarks give a most interesting account of the beginning of the work on ergot and the early years of the author's scientific endeavor. Above all, this book reenforces the generally held conviction that Sir Henry Dale has made a tremendous contribution to biological science and that he well deserves the admiration and affectionate esteem of the western world and all men of science.

CHANDLER MCC. BROOKS

PHARMACOGNOSY LABORATORY MANUAL.

By Maynard W. Quimby, Raymond W. Vander Wyk, and William E. Hassan, Jr. Burgess Publishing Company, Minneapolis. $3.00 (paper). ix + 108 pp. 1953.

The manual is divided into 3 sections, one concerned with special technics employed in microchemical extraction and the identification of biological drugs, a second with a study of harmful plants, i. e., dermatitis and allergy-producing plants, and the third with animal and plant drugs of economic importance. The volume is intended as a work-book and laboratory guide. It appears to be modern, accurate, and complete, and some pharmacologic animal tests are included.

C. JELLEFF CARR

LABORATORY MANUAL FOR ELEMENTARY PHYSIOLOGY. *Fifth Edition.*

By Lalia V. Walling. The C. V. Mosby Company, St. Louis. $3.75 (paper). 257 pp.; ill. 1952.

The comment was made in regard to the 4th edition of this manual (*Q.R.B.*, 20: 285. 1945) that the number of exercises seemed to be rather excessive and that "one wonders whether it would be possible or, for that matter, of value to the students to perform all of them." In spite of this, the principal change in the new edition (from which Kenneth Siler's name is missing as co-author) is the addition of 13 more exercises. The number of pages has thus been increased from 187 to 257. The level of the intended work remains that of the elementary college course, the exercises requiring only simple equipment and being suitable for students with little previous biological training.

THE MOTION OF THE HEART. *The Story of Cardiovascular Research.*

By Blake Cabot. Harper & Brothers, New York. $2.00. xii + 174 pp. 1954.

Cabot has very nearly succeeded in introducing the layman to the world of cardiovascular research. He gives a very interesting and coherent account of the different levels of research, basic and applied, and of the need for each. The history of our knowledge of the circulation is well told. Chapters are devoted to arteriosclerosis, hypertension, rheumatic heart disease, heart failure, and heart surgery, and all of these are informative and readable. The style is too dramatic for general medical consumption but very suitable for the lay audience. Doubtless anyone who reads this volume will have a much better emotional and factual understanding of what is going on in medical research. One of the features of the book is that contemporary personalities and research centers are not named, and thus a reasonable sense of universality is obtained. The story, however, cannot be complete without these names, and it is unfortunate that the impossibility of giving precise credit makes it wise not to mention them. The author is to be congratulated on his first book.

E. CONVERSE PEIRCE, 2ND

SYMPATHETIC CONTROL OF HUMAN BLOOD VESSELS.

By H. Barcroft and H. J. C. Swan. Edward Arnold & Company, London; [The Williams & Wilkins Company, Baltimore]. $3.75. viii + 165 pp.; ill. 1953.

This book summarizes the research of Barcroft and his associates on the sympathetic control of skeletal blood vessels, mainly as elucidated by plethysmographic methods. Work has been primarily on the forearm, hand, and lower extremity, but has been integrated with other areas. There is a brief historical orientation, and credit is given where due; but there is no attempt to summarize the literature. The net result is a very concise, readable account of numerous human experiments, many of them of classic quality.

The researches have been of a broad scope and the content of the book can best be suggested by a few of the conclusions. There are sympathetic vasodilator nerves to forearm blood vessels. Adrenalin in small amounts is a vasodilator (possibly physiologic) in skeletal muscles. Noradrenalin is probably the sympathetic mediator and causes simple skeletal vasoconstriction. The effect of sympathectomy tends not to be permanent because (a) there is rapid return of intrinsic tone, and (b) late studies show some return of innerva-

tion. Studies demonstrating that fainting results from reflex vasodilation in skeletal muscle are particularly noteworthy because of their clarity of conception and result.

All of the material is based on studies in human beings with normal arterial systems. The tremendously complicated effects of arterial disease are not discussed. This on the one hand renders the work more authoritative, and on the other indicates the very great need for well conceived and executed flow studies in arterial disease. This small monograph cannot be too highly recommended.

E. Converse Peirce, 2nd

Visceral Circulation. *A Ciba Foundation Symposium.*

Editor for the Ciba Foundation, G. E. W. Wolstenholme, assisted by Margaret P. Cameron and Jessie S. Freeman. Little, Brown & Company, Boston. $6.50. xiv + 278 pp. + 22 pl.; text ill. 1953.

This book records an international symposium, largely British, on the broad subject of visceral circulation. The participants are research workers from the several medical disciplines, anatomy, physiology, biology, chemistry, pharmacology, clinical medicine, surgery, and anesthesia. Both formal remarks and discussions are recorded. It is impossible to give an adequate idea of the contents. In a general way the conference covers patterns of vascular structure, physical problems of blood flow, neuro-humoral relationships, organ and tissue blood flow, and balance between general and visceral flow especially as it relates to medicine. Since much of the information is previously unpublished and the work of about 50 persons is included, the volume is an excellent source of information not otherwise readily available. It is well arranged and indexed and should prove a most valuable reference work.

E. Converse Peirce, 2nd

Muscular Contraction.

By M. Dubuisson. Charles C Thomas, Springfield, Ill. $6.50. x + 244 pp.; ill. 1954.

This monograph is an attempt on the part of the author to answer two questions: first, what do we know about the chemical composition of muscle? And second, what do we know about what happens when a muscle shortens and relaxes? In answering these questions the author assembles most of the important factual findings on the chemical composition of muscle and the physico-chemical changes which accompany muscular contraction and relaxation. I know of no other recent book which is so complete in this respect, and this feature alone makes it a valuable reference. According to the author, his purpose in collecting this information is to review the present status of the problem, and he makes no attempt to answer the question of the mechanism of muscular contraction. In this heyday of speculation on the question, Dubuisson's restraint is to be commended and his comments concerning it bear repeating here.

"Unfortunately, the question seems to me immature. This is due to the fact that there is almost no direct connection, up to the present, between what is known about the physico-chemical aspects of muscular contraction, which is the dynamic part of the subject and the properties of the muscle constituents which is a rather static side of the problem.

"What we really need to close the gap is more knowledge upon the *dynamic properties of these constituents when they are in the cell and in close relation with each other.*

"The more recent experiments seem engaged in this way and there is hope to arrive, in the near future, to a better connection between physiology and biochemistry."

Doubtless more experiments are needed to establish the connection between the physiology and biochemistry of muscular contraction, but the gap is not entirely due to a deficiency of facts. There is an equally notable lack of fruitful theories. Intuitional and speculative thinking have produced no satisfactory mechanisms. Reasoning from first physical principles has produced several molecular mechanisms which operate as chemical engines, but which, if any, of these functions in the living cell it is impossible to state. Bridging the gap on the theoretical side of the problem requires a sound phenomenological theory of muscle contraction, which would provide a concise summary of the phenomena to be explained by mechanisms developed from first physical principles.

F. D. Carlson

Your Brain and You.

By G. N. Ridley; Foreword by Alan M. Edwards. John de Graff, New York. $4.00. xiv + 210 pp. + 8 pl.; text ill. 1954.

The author has attempted to review recently acquired knowledge of the anatomy and physiology of the brain and to present this information in language which the "average reader" can understand. He certainly succeeds in this—one gathers, however, that his concept of average ability is that it is rather low. Despite the fact that the book seems to have been written for children, it is rather interesting in that it covers practically all aspects of the fields of neuroanatomy and neurophysiology, and contains information about the evolution of the brain, the nature of mind, electroencephalography, etc. It is gratifying to learn that tabulations of the brain weights of the eminent scholars of different nationalities show that American scholars have heavier brains than all others. They are one and a half ounces heavier than British brains but a full three ounces heavier than the brains of Germans. Seemingly the brain of only one Italian was weighed and he was almost like an American. Women, incidentally, have a much worse standing

than do the Germans, being four ounces lighter than the average male. I enjoyed scanning this volume, and I feel it could be recommended to some group of readers, perhaps to physical education majors.

CHANDLER MCC. BROOKS

DIE UNTERSUCHUNG DER REFLEXE.

By Robert Wartenberg; Introduction by H. Pette; contributors, H. Köbeke and H. Scheller. Georg Thieme Verlag, Stuttgart [Grune & Stratton, New York]. DM. 15.60 (paper). xii + 196 pp.; ill. 1952.

Much of the material of this monograph was published in English in 1944 in the *Archives of Neurology and Psychiatry*, 51: 113–133 and 52: 341–358; 359–382. It deals with the history, physiology, and nomenclature of reflexes in man. Beginning with a discussion of the basic principles of myotatic reflex action and methods of reenforcing reflex response, the author proceeds to a discussion of some twenty-five reflexes such as the orbicularis oculi reflex, head retraction reflex, finger bending reflex, the triceps reflex, abdominal muscle reflexes, the quadriceps reflex, etc. In each instance the work done by many neurologists is referred to and a good bibliography is given. Supplements deal with (1) the Babinsky reflex after fifty years, (2) The Signs of Brudzinski and of Kernig, a reprint of an article published in 1950 in the *Journal of Pediatrics*, 37: 679–684; and (3) an article on the pyramidal tract, by H. Köbcke. This volume will serve as a valuable reference work for those interested in the reflex responses of man and their use in neurological studies.

CHANDLER MCC. BROOKS

THE SENSATIONS. *Their Functions, Processes and Mechanisms.*

By Henri Piéron; translated by M. H. Pirenne and B. C. Abbott. Yale University Press, New Haven. $6.00. xxiii + 469 pp.; ill. 1952.

This is a translation into English of a book originally published in French in 1944, and based on a series of lectures prepared long before that. As such, it is dated, in spite of the fact that Piéron revised the French edition somewhat before it was translated. However, the function of the book is unique, and there is no other like it. It covers in considerable detail, and with great erudition, the entire field of sensory psychophysiology. Its primary concern is with peripheral sensory mechanisms and the sensory phenomena which can be correlated with them, but it does say a few words about the central nervous system also.

Unlike the authors of most American books in the same field, Piéron consistently speaks in the tone of authority. He discusses phenomena, not the experiments by which these phenomena are studied. With few exceptions, it would be difficult to tell from reading Piéron that there are any controversies in the field he writes about. This tone is rather pleasant, for all too often in other works the known facts get lost in a welter of methodological criticism.

The facts which Piéron presents are often personal. This book is not a record solely of Piéron's own work, but it does place the emphasis on French research, a thing startling to those accustomed to non-French handbooks. For example, of Piéron's 793 references, 42 per cent are in French while 45 per cent are in English. This proportion would probably not be duplicated in any American handbook in the same field. More seriously, a good many references which seem to be particularly important to the subject discussed are absent. For example, Piéron has a quite extensive discussion of pain, but makes no mention of Hardy, Wolff, and Goodell, or of Tower, and only in a footnote does he mention Bishop.

The translation is generally good, though the style is not outstandingly easy to read. However, the French technical terms in translation sound strange in American ears. On p. 1 we meet "reflexogenic," "dynamogenic," and "agogenic" regulation; later we run across neurons in the central nervous system called "esthesiones."

If this review emphasizes problems of scientific parochialism, the parochialism is more the reviewer's own than it is Piéron's. Reading books like this is the best cure for parochialism—and this particular book not only presents the whole field of French psychophysiology of sensation, but serves as a useful handbook of the area in general. The completely non-parochial handbook has not yet been written. Perhaps it can't be.

WARD EDWARDS

PAIN SENSATIONS AND REACTIONS.

By James D. Hardy, Harold G. Wolff, and Helen Goodell; with a foreword by Edwin G. Boring. The Williams & Wilkins Company, Baltimore. $6.50. xv + 435 pp.; ill. 1952.

This monograph results from several years of cooperative work by the authors. It contains their conclusions and a summary of their methodology, as well as the results of their specific experimentation. The book begins with a discussion of the various concepts of pain and the historical development of the study of this sensation. The nature of the pain endings, their location, and other structural considerations are next dealt with. Methods for the study of pain thresholds are described in sufficient detail to permit other investigators to employ these same techniques. The bulk of the volume is concerned with the results obtained in studies carried out with this methodology. For example, thresholds of pain in man, the nature of burning and aching pain, pain intensity, and the nature of cutaneous hyperalgesia

are dealt with. Chapters 10 and 11 are concerned with reactions to pain, and the concluding chapters deal with the cerebral cortex, perception, the pain experience, and the use of analgesic agents. There is much interesting and useful information contained in this publication. It will serve as an excellent reference book and it is particularly pleasing to read because of the breadth of concept demonstrated. The basic principles of physiology have been considered in all aspects of this work.

CHANDLER McC. BROOKS

THE NATURE OF LIGHT AND COLOUR IN THE OPEN AIR. *By M. Minnaert; translation by H. M. Kremer-Priest, revision by K. E. Brian Jay. Dover Publications, New York.* $1.95 (paper); $3.95 (cloth). xii + 362 pp. + 16 pl.; text ill. 1954.

Have you ever seen and wondered about sun-pictures, the scintillation of terrestrial sources of light at night, the beats between two sets of railings, the contrast-edges along the boundaries of shadows, the apparent increase in the size of the sun and moon near the horizon? If you have, then you should read this book. Minnaert is concerned with such things—with the how and why of shadows, reflections, rainbows, mirages, and over 100 other phenomena of light and color. In general, the phenomena discussed are those which any one can see directly without the help of elaborate instruments and without the accumulation of long series of statistical observations. The book is full of explanations and demonstrations, so that you can not only see but understand the phenomena. It's a fascinating collection of tidbits calling to our attention again the wonderful world of nature we live in.

A. CHAPANIS

PHYSIOLOGICAL ACOUSTICS. *By Ernest Glen Wever and Merle Lawrence. Princeton University Press, Princeton.* $10.00. xii + 454 pp. + 7 pl.; text ill. 1954.

As its title implies, this book deals mainly with the ear as a piece of physical apparatus, i. e., with the acoustic rather than with the biologic properties of the peripheral part of the total organ of hearing. The 18 chapters of the book are assembled in 7 groups, termed Parts. The headings of 3 of these Parts give as much of an idea of the more important contents as can be briefly conveyed. They are: The Middle Ear as a Mechanical Transformer; The Problem of Distortion; and Sound Conduction in the Cochlea.

Without a doubt, this book is an essential for every person, from graduate student to elderly professor, who is seriously interested in the physiology of hearing. As in the previous book by the senior author (Wever: *Theory of Hearing*, 1949; *Q.R.B.*, 25: 101. 1950) facts rather than theories dominate the presentation. Many of the facts have been established by the studies of the authors and their associates in their justly famous laboratory in the basement of a building at Princeton University. Some of the data from their investigations are presented for the first time in this book; many of them have of course previously been published in periodicals.

This book, like its predecessor, is far more than an assemblage of the observations that have been made by the Princeton group. The facts pertinent to the topic have been brought together from the numerous sources, not from abstracts, and have been critically evaluated. By judicious selection and careful arrangement of the factual material, the authors have rendered a real service to all future investigators of the topics treated in this book, irrespective of whether or not they arrive at the same conclusions with respect to how the ear functions.

By the use of glossy paper the appearance of the half-tone reproductions and of two of the line drawings could have been much improved. The format and press-work otherwise are excellent, and the freedom from typographical errors is, for a technical book, truly remarkable. There is a good index and a welcome list of references. The book will be in demand by specialists in the field for many years to come.

STACY R. GUILD

EXPERIMENTAL SURGERY, *including Surgical Physiology. Third Edition.* *By J. Markowitz, in collaboration with J. Archibald and H. G. Downie. The Williams & Wilkins Company, Baltimore.* $10.00. xii + 851 pp.; ill. 1954.

This fascinating and remarkable book resists classification, and its double title suggests perhaps the development of the author's original purpose. The fact is that experimental surgery today, as even the pages of the most "clinical" surgical journals attest, has very largely become the physiological study of problems of interest to the surgeon. The author's introductory remarks (these are witty, conversational, and complete with amusing quotations, but the following text might be briefer and less distracting were the style not the same) and comments in the text indicate an intention to provide a series of exercises for the medical student and the postgraduate student of surgery. Certainly this book could serve as the basis for a most rewarding course in surgical physiology and techniques in experimentation.

The plan of the book, after rather elementary introductory chapters on surgical techniques, animal care, anesthesia, etc., consists essentially in a presentation of major investigative problems in the varying fields of surgery, a detailed consideration of numerous applicable techniques with illustrations from various authors, and a rapid survey of the experimental and

clinical literature. There are sections dealing with the gastro-intestinal tract, bone surgery, intracranial surgery, pulmonary and cardiac surgery, renal physiology, a special section on the liver and another on hematology and nutrition. The result, given the author's discursive and narrative, if lively, style, is a large book of 850 pages which still has some unavoidable omissions.

One could wish in a work of this sort for a series of plates on canine anatomy in addition to the numerous clear illustrations in the text. Modern physiologic studies employ a considerable variety of devices for demonstrating and recording pressures, action currents, etc., and a chapter on the methods and criteria of evaluation would perhaps be more useful than the section on knot-tying, suture methods, etc.

No quarrel could be taken with the author's stated course of concentrating on those areas of investigation with which he has been most concerned. It is this that makes the chapter dealing with the gastrointestinal tract so complete and informative. Most of the classical physiological preparations are illustrated and described in detail, together with the development of the pertinent physiological thinking and knowledge. Here perhaps, more than in other sections, the recent work of contemporary investigators such as Dragstedt and others is given adequate space, although there is still some superabundance of old references and occasionally outmoded methods have not been expunged. While one may be impatient with the retention of the use of cutting sutures in the formation of an Eck fistula instead of the description of partial occlusion clamps and modern vascular anastomotic techniques, there is real justification for the description of the old experimental preparations, so many of which are described and illustrated in the sections on the gastro-intestinal tract. One could wish that in the other and less fully treated chapters, the standard and most useful operative preparations were also described or at least briefly catalogued with references.

There is a section on the lungs, trachea, and bronchi, another on experimental surgery of the heart, and one on the mechanical heart and cardiac arrest. These chapters, particularly the first two, are regrettably brief in view of the tremendous interest in cardio-respiratory physiology and experimentation. However, the author has succeeded in giving students of experimental surgical physiology a valuable and readable account of its problems and techniques with special attention to the fields with which he has himself been identified for many years.

MARK M. RAVITCH

THE RELATION OF LEAN BODY WEIGHT TO METABOLISM AND SOME CONSEQUENT SYSTEMATIZATIONS. *N. Y. Acad. Sci., Vol. 56, Art. 6.*

By Albert R. Behnke; Editor, Roy Waldo Miner. New York Academy of Sciences, New York. $1.25 (paper). Pp. 1095–1142; ill. 1953.

ANIMAL NUTRITION

OVEREATING, OVERWEIGHT AND OBESITY. *Proceedings of the Nutrition Symposium held at the Harvard School of Public Health, Boston, Mass., October 29, 1952. Nutrition Symposium Series, No. 6.*

By David P. Barr, John R. Brobeck, Henry W. Brosin, Louis I. Dublin, Frank A. Evans, P. C. Frey, Samuel Gurin, Paul Gyorgy, Edward E. Hunt, Jr., Ancel Keys, P. S. Peckos, and A. W. Pennington. The National Vitamin Foundation, New York. $1.50 (paper). ii + 1951 pp.; ill. 1953.

These presentations are particularly appropriate just at this time, when the public is being deluged with popular articles concerning the deleterious effects of overweight. As the title of the symposium suggests, the primary consideration is the problem of obesity, its measurement, causes, physiological and psychological effects, and its correction. While the various papers will be of considerable interest to physicians and nutritionists, possibly the greatest of the real values of the book is that it points out that our current knowledge is rather meagre and empirical.

ROBERT VAN REEN

ORAL FAT EMULSIONS. *Ann. N. Y. Acad. Sci., Vol. 56, Art. 1.*

By F. J. Stare, Conference Chairman and Consulting Editor; A. A. Albanese, G. J. Boines, M. E. Dailey, R. P. Geyer, E. M. Goldberg, A. Grollman, M. I. Grossman, S. D. Jacobson, W. J. Kolff, W. J. Kuhl, Jr., S. M. Levenson, E. A. Lounds, C. U. Lowe, I. G. Macy, C. D. May, K. A. Meyer, F. D. Moore, R. Morris, H. Necheles, J. P. Peters, M. Shoshkes, I. F. Stein, Jr., R. W. Swift, T. B. Van Itallie, W. R. Waddell, and C. C. Wang; Roy Waldo Miner, Editor. New York Academy of Sciences, New York. $3.00 (paper). 139 pp.; ill. 1952.

The undernourishment of sick people who, for a variety of reasons, cannot eat adequately, is a serious medical problem. In this symposium accounts are given of the progress made over the past 10 years in developing fat emulsions that can be taken by mouth. These include from 40 to 50 per cent fat and 5 to 10 per cent glucose. It is important that the particles of the emulsion be of very fine size, not only to improve absorption but also to increase palatability. Such emulsions will successfully put weight on individuals with cancer, tuberculosis

or other emaciating diseases. In addition to reports of clinical studies of the utilization of oral fat emulsions, the symposium included several papers of a general or experimental nature, such as: The Importance of Fat in the Diet (Swift); Fat Absorption and the Experimental Basis of Oral Fat Emulsions (Geyer); Oral Fat Emulsions in the Study of Calorie-Nitrogen Relationships in Man (Van Itallie, Moore, and Stare); Fat Ingestion and Chylomicrons (Necheles); Interrelationships of Foodstuffs (Peters); etc. The lack of an index seriously diminishes the usefulness of this publication as a reference work.

BIOCHEMISTRY

DYNAMIC ASPECTS OF BIOCHEMISTRY. *Second Edition. By Ernest Baldwin. Cambridge University Press, London and New York* $5.00. xx + 544 pp.; ill. 1952.

The first edition of this textbook of biochemistry (*Q.R.B.*, 23: 72. 1948) has made an enviable reputation among teachers and students in this field, and the consensus appears to be that it in truth lives up to the promise of its title. Tremendous advances made in the period since 1946, the date of its first publication, have necessitated a careful and thorough revision in order to bring it up to date. This has been done without any marked increase in the size of the book and without any significant change in its organization. Although biochemists on the plant side may still deplore the lack of consideration of plant biochemistry, and in particular of photosynthesis, which is adding so significantly to our understanding of intermediary metabolism, no one is likely to regard the treatment of animal biochemistry as inadequate, with the possible exception of the field of nucleoproteins. The sections on CO_2 fixation and the participation of active acetate therein are particularly well written and authoritative.

CARBOHYDRATE METABOLISM. *A Symposium on the Clinical and Biochemical Aspects of Carbohydrate Utilization in Health and Disease. Edited by Victor A. Najjar. The Johns Hopkins Press, Baltimore.* $4.00. x + 134 pp.; ill. 1952.

This symposium included 8 papers presented by leading workers in the field of carbohydrate metabolism, as follows: The Enzymatic Synthesis and Molecular Configuration of Glycogen (Carl F. Cori); Factors Affecting Liver and Muscle Phosphorylase (Earl W. Sutherland); Studies on Glycogen Disease with Report of a Case in which the Glycogen was Abnormal (Dorothy H. Andersen); Pituitary Inhibition of Glucose Uptake by the Muscle (C. R. Park); Factors Affecting the Metabolism of Glucose and Pyruvate, in vitro (A. Baird Hastings); Spontaneous Hypoglycemia: Clinical and Metabolic Studies (Irvine McQuarrie); Some Observations on the Interrelationship of Potassium Metabolism and Carbohydrate Metabolism in the Isolated Rat's Diaphragm (Evan Calkins & Isaac M. Taylor); and The Therapeutic Implications of Disturbances in Water and Electrolyte Metabolism in Diabetic Acidosis (Allan N. Butler). A Summary of the entire conference was supplied by Victor A. Najjar. In brief, it was shown that "the carbohydrate metabolism is profoundly influenced by (1) the enzymatic constitution of the individual (2) the hormonal balance and (3) the electrolyte pattern in the extracellular and intracellular fluid. . . . Disease can be caused by a deficiency of an enzyme, as in glycogen storage disease, a deficiency of a hormone, as in diabetes or hypoglycemia and a disturbance in electrolytes, as in acidosis." The Summary is primarily for the student of clinical medicine, but will be serviceable to biochemists and other biologists as well.

A TRAIL OF RESEARCH *in Sulfur Chemistry and Metabolism and Related Fields. By Vincent du Vigneaud. Cornell University Press, Ithaca.* $3.25. xiii + 191 pp.; ill. 1952.

There are far too few books like this one in the literature of science. What du Vigneaud has tried to do in these Messenger Lectures of 1950 was to retrace the trail of his own lifelong research in biochemistry, a trail originating with his first course in the field under an inspiring teacher, H. B. Lewis, at the University of Illinois, and with a lecture by W. C. Rose that awakened his profound interest in the chemistry and metabolism of sulfur compounds. From those beginnings in 1921–23, du Vigneaud went to the laboratory of the Philadelphia General Hospital, where in collaboration with W. G. Karr he began his work on glucose tolerance and insulin. The successive chapters of the book indicate the later twists and turnings of the trail: From Insulin to Homocystine; The Conversion of Methionine and Homocystine to Cystine in the Animal Body; Transulfuration; The Conversion of Homocystine to Methionine; the Concept of Transmethylation and the Biosynthesis of "Labile" Methyl Groups; The Participation of Choline, Betaine, and Related Compounds in the Process of Transmethylation; The Metabolic Fate of "Biologically Labile" Methyl Groups and the Intermediates in their Biosynthesis; and finally, From Insulin to Chemical Studies of the Oxytocic and Pressor Hormones of the Posterior Pituitary Gland. This last stage has ended brilliantly within the past year in the successful determination of the chemical structure of these two posterior pituitary hormones, a part of the story too recent to have been included here.

However interesting the actual trail of research, this

is not the most significant outcome of reading du Vigneaud's story. Rather, one comes back to the point so vividly stressed in the Preface:

"It is intriguing how one starts out on a trail of exploration in the laboratory not knowing where one is eventually going, starting out, to be sure, with some immediate objective in mind, but also having a vague sense of something beyond the immediate objective, toward which one is striving. True exploratory research is really the working out of a winding trail into the unknown. The investigator who is attracted to this type of research is attracted by the same thrill, albeit at a sublimated level, that was once enjoyed by the explorers in breaking through the confines of the old world. This is the kind of research that our academic and governmental administrations must be very careful to preserve. They must encourage the desire and guarantee the freedom for such exploration into the unknown, just as it was necessary and profitable to the administrations of the old world to allow individuals to explore the unknown geographic world."

BENTLEY GLASS

ANNUAL REVIEW OF BIOCHEMISTRY. *Volume 22. Edited by J. Murray Luck, Hubert S. Loring, and Gordon Mackinney. Annual Reviews, Stanford.* $6.00. x + 729 pp. + 1 pl. 1953.

A novel and particularly interesting feature of this volume is the prefatory chapter wherein E. V. McCollum relates his Early Experiences in the Study of Foods and Nutrition. The frontispiece is a recent photograph of McCollum, which will be greatly prized by all who know him. The relation by great research workers, as they approach the age of retirement, of the beginnings of what Vincent du Vigneaud has so aptly called "a trail of research" not only has great human interest but offers younger workers insight into the vicissitudes of scientific work that is very rarely to be found in the usual reports of successfully completed research. Not least of the values of such contributions is the inclusion in the record of many points of great significance to the history of science. In previous centuries scientists often recorded these aspects of their work, but the impersonal, cut-and-dried character of modern scientific literature affords little scope for more than the essential methods, observations, and conclusions. The editors are to be gratefully thanked for this innovation, which we may hope will be continued in future years.

The 22nd annual review contains 22 reviews, of the customary authoritative kind. They cover Biological Oxidations (Slater), Proteolytic Enzymes (Linderstrøm-Lang and Møller), Glycosidases (Hestrin); Chemistry of Carbohydrates (Isbell and Frush); Chemistry of Lipids (Hilditch); Nucleic Acids, Purines, and Pyrimidines (Brown); Carbohydrate Metabolism (Leloir and Cardini); Lipid Metabolism (Artom); Metabolism of Amino Acids and Proteins (Christensen); Chemistry of Cortisone (Shoppee); Nutrition (Hogan); Chemistry of Neoplastic Tissue (Kensler and Petermann); Biochemistry of Teeth (Leicester); Immunopolysaccharides (Tomcsik); Chemistry of Fungi (Birkinshaw); Ruminant Nutrition (Huffman); Photosynthesis (Brown and Frenkel); Biochemistry of Antibiotics (Duggar and Singleton); Biochemistry of Vision (Wald); Fat-Soluble Vitamins (Baumann); Water-Soluble Vitamins (Bessy, Lowe, and Salomon); and Chemistry of Amino Acids, Peptides, and Proteins (Fromageot and Jutisz). Much more space than previously has been devoted to the vitamins (102 pp.).

BENTLEY GLASS

METABOLIC MAPS. *By Wayne W. Umbreit. Burgess Publishing Company, Minneapolis.* $6.00. ii + 440 pp.; ill. 1952.

This tremendously useful book is a sort of graphic bibliography of major biochemical areas: The Pathway from Glucose to Pyruvate; The Phosphate System—Energy-rich Phosphate; The Citric Acid Cycle; The Reactions of Pyruvate; The Pathways to Oxygen; The Introduction of Nitrogen; The Metabolism of Amino-acids; Methyl and Other One-Carbon Compounds; The Origin and Breakdown of Aromatic Rings; The Origin and Breakdown of Nucleic Acid, Purines, and Pyrimidines; and The Lipides. There is plenty of blank space for keeping up to date both the charts and the lists of references in these rapidly developing fields. The brief, critical abstracts that accompany a majority of the references cited are almost as valuable to the serious student as the "maps." Every worker in biochemistry will feel heavily indebted to the author for the painstaking labor and ingenuity which he has put into this exemplary reference book.

BENTLEY GLASS

BIOCHEMISTRY AND HUMAN METABOLISM. *By Burnham S. Walker, William C. Boyd, Isaac Asimov, foreword by John T. Edsall. The Williams & Wilkins Company, Baltimore.* $9.00. viii + 812 pp.; ill. 1952.

This book is written for first-year medical students and uses an interesting departure from the usual organization of such texts. The major divisions are: Structure (proteins, amino acids, tissue chemistry, blood and the anemias); Control (enzymes and hormones); Growth (nucleoproteins, growth, cancer, genetics); Metabolism (food and diet, digestion, carbohydrates and diabetes,

lipids and ketosis, proteins and starvation, electrolytes and water, respiration and acidosis, heat and work, renal function); and Pathology (vitamins and vitamin deficiencies, infection). To the appendices are relegated such matters as colloids, membrane equilibria, isotopes, elementary aspects of thermodynamics, and a discussion of acids and bases.

The approach is descriptive, with emphasis on human biochemistry and little mention of comparative aspects. There is little by way of examples of experiments on which current concepts are based. Though a considerable body of information is conveyed, some question may be raised as to how much understanding can be achieved from this text. Medicine is progressing rapidly; more and more use of fundamental chemistry is being made in clinical matters. In many fields a firm foundation in the discipline of biochemistry and in elementary physical chemistry is essential. Such a foundation, on which the present student and later practitioner can build and increase his understanding of disease and treatment, is not provided in this book.

F. P. CHINARD

BIOCHEMISTRY OF DISEASE. *Second Edition.* *By M. Bodansky and O. Bodansky. The Macmillan Company, New York.* $12.00. xiii + 1208 pp.; ill. 1952.

Biochemistry of Disease is a well-written, extensive, but not exhaustive, attempt to relate biochemical findings and pathological human symptoms. It systematically discusses diseases of the various tissue and organ systems including diseases of blood, heart and cardiovascular system, respiratory tract, kidney and genitourinary tract, digestive system, liver and biliary tract, pancreas, adrenals, pituitary, thyroid, parathyroids, bones, muscles, and male gonads, and concludes with 4 chapters on more general problems. These are concerned with the implications of biochemistry in obstetrics and gynecology, with miscellaneous disorders of nutrition and metabolism, and with biochemical aspects of neurological and psychiatric disorders. As an excellent reference book, this volume certainly fulfils its purpose. The reader who desires more detailed information will find an exhaustive bibliography of original papers at the end of each chapter.

The most attractive feature of this book appears to be the excellent discussions concerning the validity and relative weight to be given to various kinds of evidence. This is particularly the case in those fields where considerable controversy occurs as to the causative agents and the etiology of disease processes. The book should serve well both the practicing physician who is curious about recent developments in the biochemistry of his field, and the research worker who wishes to find a concise review of his special problem.

BERNARD L. STREHLER

HETEROCYCLIC COMPOUNDS. *Vol. 4. Quinoline, Isoquinoline, and Their Benzo Derivatives.* *Edited by Robert C. Elderfield. John Wiley & Sons, New York; Chapman & Hall, London.* $17.00. ix + 674 pp.; ill. 1952.

This is the fourth volume of an extremely valuable compilation of articles on heterocyclic compounds. The editor, Robert C. Elderfield (Columbia University), is well known for his contributions to this broad field. He is the author of the article on The Chemistry of Quinoline in this volume. Other recognized experts contributed articles as follows: Walter J. Gensler (Boston University), Isoquinoline; Adrien Albert (The Australian National University), the Acridines; L. P. Walls (Wellcome Chemical Research Laboratory, England), Phenanthridines and Benzoquinolines. Each contribution follows the general pattern of discussing (1) methods of synthesis and (2) reactions of the heterocyclic compound and its derivatives, and (3) medical and industrial applications. The articles are not complete reviews of the literature, but they are extensively documented with key papers in the field. The duplication of material presented in previous volumes and pertinent also to the present discussion has been avoided by extensive cross-references. Volume 4 may best be recommended by saying that it has maintained the same high standards recognized in the three previous volumes.

Biologists, pharmacologists, biochemists, and others working in allied fields will be interested in having available the chemistry of these heterocyclic compounds, quinoline, isoquinoline, and benzoquinolines, whose many derivatives frequently possess biological activity.

R. M. BURTON

THE TERPENES. *Volume III. The Sesquiterpenes, Diterpenes and their Derivatives. Second Edition.* *By Sir John Simonsen and D. H. R. Barton; with addenda to Volumes I and II by Sir John Simonsen and L. N. Owen. Cambridge University Press, London and New York.* $10.00. xi + 579 pp.; ill. 1952.

In this third and last volume of the second edition of his comprehensive work on the terpenes, Simonsen has not only completed and brought up to date (as much as is possible in a work of this nature) those areas left untouched by the first two volumes, namely, the sesquiterpenes and diterpenes together with their

derivatives, but has also included addenda to bring up to date volumes I and II as well.

The same encyclopedic treatment and exhaustive literature coverage that was typical of the first edition is found in these new volumes, and this has resulted in a great expansion over the earlier work. The original method of discussing, under group headings, the individual terpenes, including both those of known and those of unknown constitution, makes these books literally indispensable to anyone who is interested in this area of the chemistry of natural products. While the commercial features of the terpenes, as such, have been largely ignored, the botanical sources of these substances are given, together with complete coverage and documentation as to their physical properties, structure proofs, syntheses, and various chemical interrelationships. The literature is covered, occasionally as late as 1950.

The labor involved in this revision has been enormous, and it is gratifying to note that for this third volume a collaboration has been established with Professor D. H. R. Barton, whose own researches are contributing much to the development of terpene chemistry. As is inevitable in a major work of this scope, in a few instances new constitutional features have been described in the literature so recently as to have rendered inclusion in the revision impossible; one might mention the betulenols and the caryophyllenes. These are very few, however, and constitute only a minor and unavoidable drawback. The paper and printing are good, and the books seem remarkably free from typographical and other errors. The series is highly recommended to anyone wishing to acquire a background to, or to learn the intimate details of, the fabric of terpene chemistry.

EVANS B. REID

ORGANIC SYNTHESES. *Volume 33.*

Charles C. Price, Editor-in-Chief. John Wiley & Sons, New York; Chapman & Hall, London. $3.50. vi + 115 pp.; ill. 1953.

This volume contains detailed procedures for the preparation of 40 organic compounds. Some of the compounds of biological interest as biochemicals or preparatory intermediates are: alloxantin dihydrate, atrolactic acid, butyrchloral, creosol, *p*-dimethylaminobenzaldehyde, dimethyl ketene, 2,2-dimethyl pyrrolidine, ethyl α-(1-pyrrolidyl) propionate, 3-methylcoumarone, nicotinonitrile, pyridine-N-oxide, and stearone. The subject index is cumulative and comprises material from volumes 30, 31, 32, and 33.

ORGANIC CHEMISTRY. *An Advanced Treatise, in Four Volumes. Volumes III and IV.*

Editorial Board: Henry Gilman, Editor-in-Chief, Roger Adams, Hans T. Clarke, Reuben G. Jones, Carl S. Marvel, Gordon J. O'Donnell, David A. Shirley, and Harry L. Yale. Contributors: P. D. Bartlett, H. E. Carter, L. C. Cheney, J. C. Cowan, R. H. Eastman, H. W. Grimmel, W. E. Hanford, W. Z. Hassid, H. R. Ing, F. A. Miller, C. R. Noller, D. E. Sargent, W. A. Waters, R. H. Wiley, and G. F. Wright. John Wiley & Sons, New York; Chapman & Hall, London. $8.75 per vol. (3) xxxviii + 580 pp.; ill. (4) xxxviii + pp. 581–1245; ill. 1953.

In the years that followed the publication of the first two volumes of Gilman's *Organic Chemistry*, the included articles became standard references for other authors. After a lapse of 10 years the editors have organized two companion volumes that should receive equally favorable attention. No topics in the new volumes were covered previously. They range widely from organic reaction mechanisms to organic dyes and chemotherapy. As in the past, each chapter is written by a leader in his field.

The general biologist will find the chapters on organic dyes, explosives, and reactions of organic gases under pressure to be fairly far afield. Certain other chapters should prove to be invaluable to the biologist who has specific questions to ask of the organic chemist. Included in this category are chapters on organic reaction mechanisms, infrared and ultraviolet spectroscopy, heterocyclic chemistry, and oxidation processes. The 5 remaining chapters are of more or less direct interest to the biologist. These deal with lipids, starch, chemotherapy, antibiotics, and terpenes.

Several chapters proved to be particularly valuable to me personally because of the presentation of comprehensive tables. Thus, the chapter on oxidation processes includes a table which relates common oxidants, susceptible groups, and products formed. The failure of theoretical organic chemistry to explain certain features of oxidation processes necessitates the compilation of such empirical data. Included in the chapter on infrared and ultraviolet spectroscopy are tables on characteristic infrared and ultraviolet absorption bands of various chemical groups. The chapter on antibiotics presents a table which lists formula, biological source and activity, and properties of many antibiotics. Although Gilman's *Organic Chemistry* is primarily directed to the advanced organic chemist, the biologist will appreciate the authoritative, documented accounts of a related science.

LAZARUS ASTRACHAN

BIOPHYSICS AND GENERAL PHYSIOLOGY

THE RADIANT UNIVERSE.

By George W. Hill. Philosophical Library, New York. $4.75. xv + 489 pp. 1952.

To a biologist, the smug assertions of physicists on

their own home ground, combined with pompous pronouncements on their destiny in biological science, are a source of considerable amusement, if not irritation. For it is conceded by most of the more exactly trained scientists who have ventured into the land of biological structure and function that the majority of important biological problems must still be handled inductively and that quantitative formulations of biological processes await more ingenious experimenters, rather than profound philosophers or mathematicians.

Therefore it was with considerable anticipation that this one biologist finished reading the cover advertisement of George R. Hill's *The Radiant Universe*, which announced the volume as "an entirely new way of looking at natural phenomena, based upon viewing all things in the universe as consisting solely of radiation." The brochure continues, "This line of investigation is followed through to considerable lengths to demonstrate its superiority over the older approach from the materialistic viewpoint." It may be suspected that the author himself composed the blurb.

On the positive side, it must be admitted that this book is attractively bound, that the print is excellent and the style entertaining, and the entire writing gives evidence of an ingenious and rebellious mind. It must have taken years to formulate a qualitative theory of such intricacy and incorporating the variety of scientific generalities and philosophical clichés it contains. Had it been written in the time of an Aquinas or even perhaps of a Darwin it would and should have attracted wide attention.

On the adverse side, the book and theory suffer from several overwhelming defects. The chief of these is the biased salesmanship which predominates throughout, advancing the author's favorite prejudice by slight-of-word tricks in the best sophistic tradition. Hill is not visibly concerned with his own glib assumptions and rational fallibility nor with the fact that most, if not all, limited accumulations of data permit multiple interpretations, particularly on a qualitative basis. Even granting that its assumptions were valid, *The Radiant Universe* falls far short of its announced scientific mission, in that it relies almost entirely on qualitative arguments which might frequently be accepted or rejected on the basis of existing physical data. But the author is obviously too concerned with his creation and too identified with it to subject it to whatever rigorous tests might exist in the published literature. His general procedure is to develop one qualitative half-truth by either-or reasoning (e. g., red shift, relativity) and then to proceed to compound the injury exponentially. As an attempt to confound the physicists in their own cosmological province, the volume fails miserably, both because of its inherently verbal, philosophical, unscientific approach and because neither physical nor biological problems are ever solved by those who are quantitatively unfamiliar with the experimental findings.

BERNARD L. STREHLER

MICROBIOLOGY

MICROBIOLOGY.

By Louis P. Gebhardt and Dean A. Anderson. The C. V. Mosby Company, St. Louis. $5.75. 414 pp.; ill. 1954.

This textbook is intended for a first course in microbiology for students with a limited background in chemistry and biology. It is divided into three sections: General; Sanitary and Industrial; and Pathogenic Microbiology. The text is clear and simple, and the book would serve its purpose very well except for the fact that it contains an unnecessarily large number of misprints, misspellings, errors, and dubious interpretations. It is incorrect to state (p. 121) that the exact chemical structure of streptomycin is unknown. Pasteur lived from 1822 to 1895, not 1850 to 1890 as stated (p. 126). Tween 80 (p. 314) is a dispersing agent for obtaining diffuse subsurface growth of tubercle bacilli after isolation, and is not an essential growth factor for initial isolation. In the chapter on Safe Swimming there is a curious comment on the drinking habits of swimmers: "It is recognized that only poor swimmers drink much of the bathing water, while good swimmers who are thirsty apparently drink only widely advertised beverages."

It is a great pity that the authors of textbooks do not more commonly have someone go over the manuscript or proofs for errors before printing and publication. If this were routinely done, there would be fewer adverse reviews (such as this one) of the published book.

WALTER C. TOBIE

FUNDAMENTAL PRINCIPLES OF BACTERIOLOGY. *Fourth Edition.*

By A. J. Salle. McGraw-Hill Book Company, New York, Toronto, and London. $8.50. x + 782 pp.; ill. 1954.

The present fourth edition is of the same general character as the third edition of this valuable textbook (*Q.R.B.*, 23: 266. 1948), but it has been expanded and brought well up to date. As in the previous edition, the approach is strongly chemical. Accordingly, the first few words in the "blurb" inside the dust-jacket announcing that the book is "written for beginners" require some qualification. The book is an excellent one for beginners in bacteriology *provided* they have an exceedingly solid background in chemistry, particularly biochemistry. The student with only one course in organic chemistry will have some very heavy going

with parts of the text, such as the section on the "mechanism of alcoholic fermentation."

Checking this edition against the previous edition, we find that the data on folic acid have been corrected and brought up to date. On the other hand, praise of sulfanilamide as a dusting powder for war wounds is still retained, although this use is now obsolete and discredited. Nor is it correct to state that "very little is known concerning the chemical composition of pigments." The structural formulas of prodigiosin, pyocyanine, chlororaphine, and iodinin were known over 10 years ago. These are minor criticisms, since it is just not possible to write (or revise) a text as extensive as this one without some errors. As a strongly chemical approach to bacteriology, the book is outstanding and should be of great value both as a textbook and as a reference work.

WALTER C. TOBIE

BASIC BACTERIOLOGY LABORATORY MANUAL.
Edited by P. L. Gainey, Thomas H. Lord, and W. A. Miller. Burgess Publishing Company, Minneapolis. $2.25 (paper). viii + 81 pp. 1953.

This is another well-reproduced manual in mimeo or offset process, with a spiral binder. It was designed for a first course in bacteriology at the Kansas State College. The 46 laboratory exercises are printed on the left, with the right-hand pages left blank for students' notes. Some stress is laid upon the bacteriology of water, milk, and soil. Pathogenic bacteriology also receives attention. One weak feature is the "key to bacteria in unknown mixtures" (p. 70), which is far from clear. Otherwise, the manual is an excellent one.

WALTER C. TOBIE

LABORATORY ASPECTS OF GENERAL BACTERIOLOGY.
By Stanley E. Hartsell and Peter L. Sguros. Burgess Publishing Company, Minneapolis. $3.00 (paper). iii + 156 pp. + descriptive chart; ill. 1953.

In the current heavy output of lithoprint or offset, spiral-bound laboratory manuals of bacteriology, mostly of mediocre quality, the present manual is outstanding because of its excellence. Both the text and the abundant illustrations are well reproduced, and should serve their purpose extremely well. The experiments are (as the title indicates) mainly in general bacteriology, but with some slight attention to molds and to medical bacteriology. The text is printed on both sides of the pages, with occasional blank spaces for the insertion of the student's observations. The manual was originally worked out for a 1-semester course at Purdue University for students who were not majoring in bacteriology. However, it might serve very well indeed for a first course even for students who expect to take further work in the subject. In a cursory examination, no errors of fact or interpretation were noticed. The work is highly recommended for examination by those who wish to give a really comprehensive laboratory course in general bacteriology.

WALTER C. TOBIE

A MANUAL FOR PATHOGENIC BACTERIOLOGY.
By Henrik J. Stafseth, John P. Newman, and Jack J. Stockton. Burgess Publishing Company, Minneapolis. $2.35 (paper). ii + 138 pp.; ill. 1953.

This spirally bound, offset manual was developed at the Department of Bacteriology and Public Health, Michigan State College. The first 68 pages deal with the general characteristics of bacteria pathogenic to man and animals, in a series of laboratory exercises which unfortunately are not numbered. The last 70 pages are devoted to study outlines for individual species. In this section of the manual, neither the pages nor the study outlines are numbered. This lack of organization mars what would otherwise be an excellent work.

WALTER C. TOBIE

GUIDE TO THE CLASSIFICATION AND IDENTIFICATION OF THE ACTINOMYCETES AND THEIR ANTIBIOTICS.
By Selman A. Waksman and Hubert A. Lechevalier. The Williams & Wilkins Company, Baltimore. $5.00. viii + 246 pp. 1953.

Within the past 14 years, soils and other naturally occurring substrates from the far corners of the earth have been vigorously combed for actinomycetes which will produce medically useful antibiotics and other metabolic products of commercial interest. The success of these ventures is reflected in the multimillion dollar antibiotic industries now operating in this country and abroad.

In response to the expanded interest in the actinomycetes, the authors have assembled this handy guide to aid the student of actinomycetous antibiotics to identify both the organisms involved and the antibiotics which they produce. Part I consists of a revision of the senior authors' earlier contribution to the 6th Edition of the Bergey *Manual* (1948), and includes new descriptions of actinomycetes published since that time. Part II contains two keys to the identification of actinomycetous antibiotics and an alphabetically arranged section wherein brief summaries of the chemical and biological properties of 107 named and unnamed antibiotics are given.

Thus far, certain species of the genus *Streptomyces* are the only actinomycetes producing medically important antibiotics. The number of described *Streptomyces* species in the guide is double that published in the last Bergey *Manual*. Part of the greatly expanded list

is logically due to proposed new, antibiotically active species of *Streptomyces*, but I fail to see the logic in elevating some 28 named cultures to species rank when their descriptions were so poor or inadequate that they were previously relegated to the appendix section of the Bergey *Manual*. However, the authors are to be commended upon their recognition that this genus can be subdivided into several broad groups each centering around a well established species. The limited usefulness of the two antibiotic identification keys in Part II are recognized by the authors. The orderly discussion of each individual antibiotic and citation of specific references therewith constitute a commendable improvement over the organization chosen by the reviewer in a previous review of a similar nature. It is regrettable, however, that only 13 of the 58 selected general references are numerically cited in the text.

ROBERT G. BENEDICT

VIRUSES AND MAN.

By F. M. Burnet. Penguin Books, Melbourne, London, and Baltimore. 50 cents (paper). 198 pp. + 6 pl.; text ill. 1954.

This little volume, by an outstanding leader and authority in virology, was written for the general reader with a non-technical education, but will be found highly informative to all who are not especially acquainted with this field. Burnet has succeeded admirably in presenting detailed, up-to-date information in non-scientific language without "talking down" nor dramatizing the subject. In the author's own words, he has made "an attempt to expound some of those aspects of the new science of virology that are relevant to matters of normal human interest."

The essential facts now known about the viruses as a part of the biological world are presented, as well as an account of certain virus diseases. These are: herpes simplex, poliomyelitis, influenza, the common cold, german measles, psittacosis, smallpox, vaccinia, yellow fever, and dengue. One chapter is devoted to the physical nature of viruses, but the author indicates in specific terms that he regards what viruses do as much more important than what they are, a statement reminiscent of Pasteur's similar one concerning bacteria. It is not surprising, then, that the viruses are discussed mainly in terms of their natural history, ecology, capacity for genetic change, and evolution. This is the point of view that Burnet has used so effectively in previous writings more technical in nature. The interaction between the virus and its human or animal host is presented as an example of the general phenomenon of parasitism, and the validity, for all practical purposes, of the postulate that viruses are living entities is amply illustrated.

In the last chapter the author indulges in interesting and stimulating speculation concerning the appearance through evolution of disease agents, of new diseases, and their possible use in warfare. From this he goes on to a plea for an attack on the social ills of the world by the scientific method that has proved so successful in enabling us to control infectious disease.

The illustrations in the book show the appearance of various viruses under the electron microscope, and representative operations in the virus laboratory. There is an index.

F. M. Burnet writes in a smooth, easy, personal style, takes the reader into his confidence, and presents complex matters lucidly. All in all, he has written what should be a very successful book.

FRANCIS B. GORDON

THE PHYSICS OF VIRUSES.

By Ernest C. Pollard. Academic Press, New York. $5.50. xi + 230 pp.; ill. 1953.

This is an imaginative and stimulating book. Much can be done to unravel the structure and function of viruses by an extensive use of existent physical tools. Pollard has, however, attempted to see far into the future and presumably is drawing rough sketches on a piece of scrap paper as he goes along. Some of these have been dressed up a bit and serve as illustrations.

It was of interest to find outlined here the ways in which thermal inactivation, ionizing radiation, ultraviolet light, etc., may be used to study virus structure; but I was bothered by the casual way in which poorly documented "properties" of viruses were analyzed and woven in with suppositions to yield an amazing array of patterns. Yet all of this will probably stimulate virologists to think some more. It is too bad that the several electron micrographs published here are really not as good as might be expected with modern electron microscopes.

FREDERIK B. BANG

VIRUS AND RICKETTSIAL CLASSIFICATION AND NOMENCLATURE. *Ann. N. Y. Acad. Sci., Vol. 56, Art. 3.*

By Sir MacFarlane Burnet (Conference Chairman), M. H. Adams, C. H. Andrewes, F. C. Bawden, G. H. Bergold, A. A. Bitancourt, L. M. Black, G. J. Buddingh, J. D. W. A. Coles, H. R. Cox, G. Dalldorf, W. McD. Hammon, F. O. Holmes, H. Koprowski, J. Johnson, P. Lépine, P. Limasset, H. H. McKinney, E. Mayr, J. L. Melnick, K. F. Meyer, C. B. Philip, G. W. Rake, A. J. Rhodes, A. B. Sabin, J. E. Smadel, E. A. Steinhaus, and J. Warren. Editor: Roy Waldo Miner; Consulting Editor, Hilary Koprowski. New York Academy of Sciences, New York. $4.00 (paper). Pp. 381–622; ill. 1953.

This series of Papers is the result of a Conference on Virus and Rickettsial Classification and Nomenclature,

held by the Section of Biology of the New York Academy of Sciences on January 11 and 12, 1952. There are 31 papers, each by an outstanding authority on the particular subject. The papers are concise and excellent reviews of the status of classification and nomenclature of the virus and rickettsial groups. It would be impossible to comment on each article in a brief review, but the list of authors is sufficient to indicate their calibre.

E. I. PETRAN

SOIL MICROBIOLOGY.

By Selman A. Waksman. John Wiley & Sons, New York. $6.00. vii + 356 pp.; ill. 1952.

The field of soil microbiology is not well served by textbooks, and the treatments of this subject in books on soil science and general microbiology are mostly quite inadequate. The announcement of a new textbook by Selman A. Waksman was therefore widely welcomed in view of his eminence in this field. His earlier volumes, *Principles of Soil Microbiology*, which appeared in 1927 and 1932, and *Soil and the Microbe*, which was prepared with his colleague, Dr. R. L. Starkey, in 1931, differed greatly in character. The former was a compendium indeed, widely used as a reference book. In the latter the main principles of soil microbiology were more clearly expressed.

In his Preface to the new book, Waksman explains that it is "a logical outgrowth of the older volumes . . . ," and that he has "drawn heavily upon the texts as well as upon the tables and illustrations of these earlier publications." As I read on, it was with a growing sense of disappointment and indeed dismay that it was realized that the second quotation above was only too true, and that although almost a quarter of a century has passed, the new book reflects little progress in subject-matter or idea. Perhaps soil microbiology has been becalmed in the doldrums, and there is not much progress to report. Certainly the more recent work has not revolutionized the field, unlike the case in some other branches of biology. Older work is not necessarily to be discredited or discarded just because it is old, but it certainly needs to be reevaluated in the light of more recent findings and new techniques. One has an uneasy feeling that the experimental basis for some of the dogma that has become accepted by repetition would no longer be regarded as convincing.

A large number of tables and figures is included. Many of the latter are graphs. Few are referred to in the text, and many appear on pages where they are not directly relevant to the subject-matter. The latter, of course, is a mechanical problem in bookmaking which besets most authors. If, however, the reader is expected to draw his own conclusions from tables and figures, it is vitally important that the legends be ample and accurate, which is not so in all cases. One figure appears twice under different numbers, 39 pages apart. The source of the data given in many of the tables and figures is recognized by giving the names of the authors, but not the citation or year of publication. Had the latter been given, it would have been apparent how old are many of the data cited. For example, Table 76 purports to indicate the effect of cultivation upon numbers of soil bacteria. No reference to it is made in the text, but the conclusion which the reader is presumably intended to draw is that there is a progressive rise in bacterial numbers for days after cultivation. The name of Chester is attached to this table, which probably means that the work was done prior to 1910 and without any concept of the importance of adequate sampling and the statistical treatment of bacterial counts if reliance is to be placed upon relatively small differences in numbers. Moreover, the conclusion which the reader may draw is probably at variance with the truth, which is almost certainly that a peak in numbers would occur a few days after disturbing the soil, after which there would be a slow decline to a level somewhat above the initial count.

In some chapters the subject-matter does not reflect the work of the past ten years. This is particularly the case with nitrogen fixation. The list of nitrogen-fixing organisms is incomplete and inaccurate. No reference is made to the elegant methods, involving isotopic nitrogen, which establish unequivocably whether or not an organism possesses this property. The genetic aspects of the rhizobia–legume relationship are not touched upon, nor is there adequate discussion of competitive effects between rhizobia or between rhizobia and other organisms.

In Chapters 11 to 15, Waksman considers under various headings the relationships between soil organisms and the growth of higher plants. He deals with the rhizosphere, with antibiotic production, with soil pathogens, and with soil fertility. The reader will, however, be left in some doubt as to whether antibiotic effects are of importance in the microbial population and whether it is likely that microbial products in soil directly affect the growth of plants adversely or beneficially. Waksman seems to discount the significance of antibiotic effects in soil on the grounds that "(a) the production of antibiotics is dependent upon the presence of specific nutrients which usually are not found in normal soil; (b) some antibiotics are readily destroyed by different soil-inhabiting microorganisms; (c) the soil organisms exposed to the action of antibiotics tend rapidly to develop resistance to them; (d) the survival or predominance of various microorganisms in the soil does not appear to be correlated with the capacity of such organisms to produce antibiotics." On the other hand, Waksman appears to support the view that beneficial effects on plant growth may arise from the microbial production of certain hormones and vitamins. "There is no doubt, however, that addition of organic matter, especially stable manures, to the soil results in favorable effects upon plant growth, which cannot be

ascribed to the mere inorganic fertilizer constituents of the manure." To me there is an inconsistency in these positions which suggests that the subject needs the most careful investigation.

Waksman's distinguished work in the field of antibiotics may have left him little time to consider the changes in viewpoints that have occurred in soil science. There is much less tendency now to consider soil microbiology as an independent science than was the case 20 years ago. Neither in subject-matter nor viewpoint is this a book of 1953.

A. G. NORMAN

PARASITOLOGY

CHEMICAL PHYSIOLOGY OF ENDOPARASITIC ANIMALS. *By Theodor von Brand. Academic Press, New York.* $7.50. x + 339 pp. 1952.

Relatively little attention has been directed to the physiology of animal parasites. In the past investigators have concentrated on morphology, taxonomy, and the complicated life histories. Although there is still much to be learned by pursuing these fields, the greatest hope for future advances is believed to lie in the study of the vital organic functions of the parasites. During the past 15 years, increased interest has developed in the physiology of parasites, and it is very appropriate that we should have a review of the past accomplishments. We are indeed fortunate to have this made possible in the present publication by one of the leaders of this complicated field.

Von Brand has admirably summarized our knowledge of the chemical physiology of endoparasitic animals in a surprisingly understandable and readable book. It is divided into 3 parts—chemical composition of endoparasites, metabolism of endoparasites, and chemical host-parasite relationships. At the beginning of practically every chapter (20 in all) there are introductory remarks by the author which help to orient the reader to the subject before the specific findings of various workers are presented. The greatest part of each chapter is devoted to the helminths, but the limited investigations on the protozoa and arthropods are not neglected.

In addition to presenting an authoritative summary, the author has rendered a valuable service by gathering together the relevant literature on the subject which is scattered in many periodicals and frequently hidden behind non-physiological titles. Each chapter usually has a couple of pages of references, and at the end of the book there are both author and subject indexes.

M. M. BROOKE

HEALTH AND DISEASE

AN INTRODUCTION TO MEDICAL SCIENCE. *An Elementary Text on Pathology. Fourth Edition, Revised. By William Boyd. Lea & Febiger, Philadelphia.* $4.50. 304 pp. + 3 pl; text ill. 1952.

This book is designed for the elementary student of medical sciences and serves its purpose admirably. A nursing course in pathology can only provide essential facts, and Boyd does this with excellent selectivity. First he gives a short preliminary summary of the important facts of anatomy and physiology, as well as a brief historical survey of medical accomplishments. With this background he systematically surveys the field of general and special pathology, and correlates anatomical changes with clinical symptoms and treatment. Obviously, in so short a volume that covers so large a field, the author cannot delve deep into any subject, nor does he desire to do so. Instead he provides an excellent elementary textbook on pathology for nursing students, laboratory technicians, physiotherapists, and even for biological students who may desire a brief survey of human disease.

ELLA H. OPPENHEIMER

ANNUAL REVIEW OF MEDICINE. *Volume 5. By Windsor C. Cutting, Editor; Henry W. Newman, Associate Editor. Annual Reviews, Stanford.* $7.00. x + 490 pp. 1954.

In this well-known and useful annual publication, the chapters on diseases of the gastrointestinal tract, cardiovascular system, kidney, reticuloendothelial system, nervous system, and respiratory system will principally be of interest to medical men. The sections on antimicrobial therapy, endocrinology, allergy, neoplastic diseases, psychiatry, physical agents and trauma, anesthesia, radioactivity, laboratory methods, and toxicology will also be of interest to other workers in the biological sciences. The reviews on pediatrics, dermatology, and dentistry will probably be of major usefulness to practitioners in those fields. However, there is an annotated list of reviews in medicine (pp. 415–448) containing material of interest both to medical men and to specialists in various biological fields. As usual, the different sections appear to be of high quality and will merit careful attention by those interested in the subject matter.

WALTER C. TOBIE

DISEASE AND ITS CONQUEST. *By G. T. Hollis; with a foreword by Maurice Davidson. Geoffrey Cumberlege, Oxford University Press, London, New York, and Toronto.* $2.50. viii + 163 pp. 1953.

Attempts to educate the public in matters pertaining to the diagnosis and treatment of disease by way of a simply written volume have almost all fallen short of the goal. Various reasons for this failure have been sug-

gested, but the two most outstanding are probably: (1) when attempted by a physician, the difficulty of viewing the subject through the eyes of the public and of presenting it in sufficiently non-technical language to be understood; and (2) when prepared by a layman, insufficient medical background to make the work authentic and technically accurate.

The present volume suffers from neither of these factors, since the author is (1) not a physician, and (2) as a layman, he has had 30 years experience in editing and publishing technical works on medicine, surgery, and their allied sciences. As a matter of fact, the value of the work is considerably enhanced by these unusual features in its origin. Prepared not so much for the masses as for the educated public, the work is written in a cultivated and temperate manner with a slightly philosophical vein that should appeal to the discerning reader.

The author's main objective is that of explaining the processes whereby the body becomes diseased and of making plain some of the reactions involved in illness and recovery. In pursuit of this objective, the writer has selected some sixty diseases for discussion to illustrate particular modes of causation, diagnosis, or treatment. Sufficient detail is included so that, even though no one will learn how to diagnose or treat a given disease, every reader should learn something of how illness is diagnosed and treated. A detailed index is appended.

B. AUBREY SCHNEIDER

THE UNITED STATES PUBLIC HEALTH SERVICE, 1798–1950.

By Ralph Chester Williams. Commissioned Officers Association of the United States Public Health Service, Washington. $7.50. 890 pp. + 140 pl.; text ill. 1951.

The United States Public Health Service had its origin in An Act for the Relief of Sick and Disabled Seamen, passed by the Fifth Congress of the United States, and approved by President John Adams on July 16, 1798. The bill provided for the collection by the U. S. Treasury of twenty cents per month from the wages of seamen working aboard United States vessels, the money to be used "to provide for the temporary relief and maintenance of sick or disabled seamen in the hospitals, or other proper institutions. . . ." The bill also authorized the President, after sufficient funds were accumulated, "to cause buildings, when necessary, to be erected as hospitals for the accommodation of sick and disabled seamen." An amending Act of March 2, 1799, extended the benefits of the original Act to the officers and men of the Navy, and the Secretary of the Navy was authorized to deduct twenty cents per month from the wages of all Navy personnel for that purpose. Thus the men of the Navy as well as those of the merchant marine were eligible for care in the hospitals of the U. S. Marine Hospital Service (1798–1902). With the purchase of the Marine Hospital at Washington Point from the State of Virginia in 1801, the United States Government was soundly established in the field of medical care for at least one segment of its population. From this meager beginning there has developed the United States Public Health and Marine Hospital Service (1902–1912), and finally the United States Public Health Service (since 1912), to provide, through numerous means, health service to the population of the entire country.

In this 900-page history of the U. S. Public Health Service, the author has traced the origin and evolution of such public health activities as quarantine, laboratory research, field studies, and demonstrations, both national and international. The author has also pointed out the broad scope of the Service's activities as they relate to the States and to other Departments of the Federal Government in such diversified fields as Vital Statistics, Mining, Indian Affairs, Pure Food and Drugs, Housing, and Medical and Vocational Rehabilitation. The many functions of the Public Health Service in times of war are also thoroughly discussed.

The work, well documented and profusely illustrated, stands as a real monument to the creditable accomplishments of a devoted group of public servants.

B. AUBREY SCHNEIDER

HEMATOLOGY *for the Medical Technologist.*

By Charles E. Seiverd. Lea & Febiger, Philadelphia. $3.50. 180 pp. + 7 pl.; text ill. 1952.

According to the Preface, this manual is intended to "supplement the technician's instructions to the student in training, . . . [and] second, . . . to aid students in their preparation for the Registry examination." A group of technicians cooperated in selecting and organizing the material, and credit is given to teachers, students, and physicians who suggested, criticized, and aided in the writing. The result is certainly a very compact and unusually clear little manual. It is, however, only capable of providing a very rudimentary approach to the standard hematological techniques and can scarcely instruct a student in the principles and important relations of hematology. Thus one who really wants to understand what is known today of blood clotting or blood grouping will have to look elsewhere. The chief danger of a simplified manual like this is that its users may think it sufficient, and be satisfied with cookbookery.

BENTLEY GLASS

THERAPEUTIC ABORTION. *Medical, Psychiatric, Legal, Anthropological and Religious Considerations.*

Edited by Harold Rosen. The Julian Press, New York. $7.50. xxii + 348 pp. 1954.

It is heartening to see this scholarly symposium of some twenty chapters dealing with therapeutic abortion, a controversial and sometimes embarrassing subject the discussion of which has generally been avoided by American physicians. The contributors—a veritable galaxy of specialists—have obviously tackled their difficult task thoroughly and with technical competence.

While Rosen and his associates cover all aspects of therapeutic abortion—medical, psychiatric, legal, anthropological, and religious, with several forays into related subjects, such as contraception, sterilization, and involuntary sterility—most of the authors are psychiatrists and place their primary emphasis on mental and emotional health. Psychiatrists have come to be progressively concerned with therapeutic abortion not only because they are often called upon to decide whether the condition of a patient requires the interruption of her pregnancy, but also because the patient's reaction to the operation may require help and guidance. On the other hand, the achievements of internists and obstetricians in protecting the life and health of the mother have been such that the interruption of pregnancy on medical indications, other than psychiatric ones, has become rare, as is pointed out in the chapter on The Shrinking Non-Psychiatric Indications for Therapeutic Abortion, by Alan F. Guttmacher.

Psychiatrists often find it difficult to explain to outsiders the why and how of what they do. This book should help us to understand the psychiatric approach to therapeutic abortion. Among the non-psychiatric contributions, one which will be of particular interest to readers of this journal is A Typological Study of Abortion in 350 Primitive, Ancient and Pre-Industrial Societies, by George Devereux.

CHRISTOPHER TIETZE

YOUR FEET ARE KILLING YOU.

By Simon J. Wikler; Foreword by Thomas Hale, Jr. Frederick Fell, New York. $3.50. x + 214 pp.; ill. 1953.

The title of this book is not used as an eye-catching facetious comment about a foot-sore individual. The author, described as a "Doctor of Surgical Chiropody," uses the words in their literal sense. He believes that foot imbalance is responsible for such "degenerative diseases" as cancer, rheumatic fever, chronic fatigue, diseases of the uterus, sexual disturbances, neuroses, essential hypertension, chronic alcoholism, narcotic addiction, allergies, eyestrain, and dental caries. He postulates that proper foot care will do much to eliminate these ailments.

The chain of events leading to the development of these diseases is described as follows. The modern shoe deforms the human foot, causes the muscles to shrivel, and leads to foot imbalance. Even the feet of infants are distorted because they are firmly tucked in under blankets or covered by tight stockings. Upon bearing weight, the deformity of the feet leads to a rolling out of the legs that carries the femora into external rotation. This deprives the pelvis of its anterior support, and allows it to dip downward in front. The spine is therefore forced into exaggerated curves, so that the abdominal space is reduced and the chest cavity is compressed. The vital organs and the blood vessels and nerves are displaced or abnormally stretched. The abnormal stresses lead to cancer of the breast, stomach, prostate, and uterus. To subtantiate his thesis the author offers case histories and statistics. In addition to the development of this concept, the writer uses the latter part of the book to enumerate some foot ailments and to describe briefly the symptoms and treatment.

I. WILLIAM NACHLAS

CANCER IN MAN.

By Sigismund Peller. International Universities Press, New York. $12.00. xviii + 506 pp.; ill. 1952.

This is a unique and interesting volume to be studied by all who are interested in the cancer problem, "physicians and scientists, teachers and workers in public health, officers of cancer societies and board members, legislators who appropriate funds for cancer research, and executives of life insurance companies," to whom the book is directed. It is of special value to these persons because cancer in man has here been analyzed from an epidemiological standpoint. Experimental work on animals, which has received so much emphasis in the last 30 years, is contrasted with the occurrence and incidence of cancer in man. The ability of many carcinogenic agents to develop specific cancers in specific organs of the body is elaborated. The author stresses the study of cancer in man since our fight is against human cancer. The material for this treatise has been obtained from epidemiological studies by the author over the past thirty years in the United States and many countries in Europe, and a thorough knowledge of the literature dealing with cancer is displayed.

To understand the plan of cancer control outlined in Part III, one must realize that stimulating agents may have "by-effects upon the incidence of primary cancer in organs other than those reached by the respective agent or stimulus." Also it is averred that mortality and morbidity statistics are more valuable today than in former years.

Part I deals with the Pathology of Human Cancer including the cellular concept and histogenesis, outstanding results of experimentation, and the evaluation of experimental trends. Part II is devoted to a review of the Epidemiology of Cancer. Much interesting material is presented here, such as cancer disposition in groups, in childhood, in population sectors, cancer as determined by occupation, reproductive activity and cancer, cirrhosis of the liver and cancer, dermotropic, bucco- and pneumo-tropic influences, etc.

From this elaborate study the author formulates a plan of cancer control which he contends will "save from death almost 90% of cancer victims." The essence of the theory is illustrated by his statistics, which show that a higher incidence of skin cancer, which is rarely fatal, will reduce the incidence of more fatal internal cancer. "Exposure of a population to carcinogenic agents which (a) provoke the development of tumors of a low case fatality ratio, and (b) are too weak to increase considerably the incidence of cancer carriers above the norm (that is approximately 20% of all adults) will prevent the development of highly fatal tumors in other organs. . . . The net result is bound to be a cancer mortality diminished by almost 90%. . . . The earlier in youth that exposure starts, the more effective will be the results." This is a startling theory. If true, and if put into practice, the cancer menace would be reduced tremendously. However, before it is accepted the theory must be put to practical tests on large groups of the population, and these volunteers must be watched over a long period of years. The theory will bear careful study and a real trial.

GRANT E. WARD

PATHOGENESIS OF CANCER AND APPLIED THERAPY. *By John E. Gregory. Bruce Humphries, Boston.* $7.50. 182 pp.; ill. 1952.

The author presents a convincing, well documented, highly technical treatise with the thesis that the cause of cancer is a definite cancer virus. After reading his extremely interesting book, one cannot help but feel that it will not be many more years before the question whether there is a virus cancer or whether some cancers are a reaction to a virus is settled.

ROBERT G. CHAMBERS

HEADACHES. *Their Nature and Treatment.* *Stewart Wolf and Harold G. Wolff. Little, Brown & Company, Boston.* $2.50. xii + 177 pp. + 7 pl.; text ill. 1953.

Since about 80 per cent of the American population suffer from headaches at one time or another, this little volume, which presents something of their nature and treatment, should receive widespread interest. Compiled by two of the most highly respected neurologists in the country, the materials are presented with authority and scientific accuracy, and in such a manner as to facilitate complete understanding by the general public.

The authors have found that by far the greatest number of headaches are traceable to one or more of three fundamental mechanisms, as follows: (1) vascular, involving pulling or displacement or distension of blood vessels, usually arteries; (2) muscle tightness, resulting from sustained contraction of muscles with or without a local reduction of blood flow; and (3) mucous membrane, consisting of swelling and engorgement of structures in the nose and adjacent air spaces. Some 90 per cent of the headaches in the first two categories and a large proportion of those in the third are brought on by the individual's attempts to adjust to daily problems and challenges. This being the case, the writers feel that the most frequently applicable treatment for headaches is attention to the whole patient, in his social setting, with all his subtle fears, apprehensions, cares, and drives. Sufficient case histories are presented to show that many sufferers of headache have been largely able to overcome their malady once they were provided with an opportunity of learning the mechanism involved in their difficulty, and have been given some assistance in warding off the stimulating influences which set the mechanism into operation.

B. AUBREY SCHNEIDER

BODILY PHYSIOLOGY IN MENTAL AND EMOTIONAL DISORDERS. *By Mark D. Altschule. Grune & Stratton, New York.* $5.75. x + 228 pp. 1953.

In his introduction to this honest and well documented monograph Altschule regrets that some physicians, particularly those with psychosomatic inclinations, will understand little of the contents of the book. This is unfortunately true. Speaking for one who has examined a great deal of the psychosomatic studies published today, I find it difficult to avoid the conclusion that, as a whole, psychiatrists are a tender-minded group, afflicted with a compulsion neurosis manifested by an overwhelming desire to believe the preposterous. It is a curious fact that in all their vast literature purporting to demonstrate the so-called role that the psyche plays in causing disease or even, say, on the origin and physiologic mechanisms of psychosis or neurosis, there is scarcely a paper that makes much sense. The art and symbolism of their cult has remained practically unchanged through the ages. Their present-day hypothesis differs little from the doctrine of the priests of ancient Babylonia who maintained that all emotions and ills come from the seat of the

soul, which in those times was the liver (only recently has it moved to the heart). Nor is their principal thesis much different from that of the modern Iroquois witch doctors who firmly believe that all diseases in which no blood is showing represent a desire of the mind. It appears that a psychosomaticist's faith in the psychic origin of disease is too deeply rooted to be easily changed, and I doubt that the data presented in Altschule's monograph will do anything to shake that belief.

Why such credulity should come more naturally to psychiatrists than, say, to the followers of Mary Baker Eddy, is difficult to explain. Is it that the profession requires a special emotional or intellectual make-up? That is questionable, for even internists, as a group, have had their share of individuals with warped or hysterical personalities, yet such cuckoos haven't completely dominated the thinking of their flocks for 5,000 years, as has been the case with the mind healers. Is it that so few psychiatrists are well informed in even the elementary architecture and plumbing of the body? Probably, for how else can one account for their hypotheses that always seem to crash head on into harsh physiological facts? But yet, although such ignorance has prevailed among a large body of surgeons and even obstetricians, still those groups appear to have achieved some measure of progress in the past 5,000 years. It is quite obvious that an answer to this baffling problem is not simple. What seems to remain as a major difference between psychiatrists and other practitioners of the medical arts is that the former find it more difficult to distinguish between what is subjectively agreeable from what is objectively evident.

It is this difficulty in their thinking that undoubtedly compels them to resort so frequently to symbolic explanations. Some of these are fascinatingly idiotic, such as the idea that high blood pressure is a phallic symbol because a mercury sphygmomometer is used to study it. (This, incidentally, has caused Altschul to wonder what the symbolic formulation would be if an aneroid manometer were employed.) Finally, they cannot realize that the psychosomatic philosophy is nothing but a metaphysical mishmash created to explain what is currently unexplainable.

Few would deny the fact that psychological factors will affect the behavior and capacities of individuals during the course of any illness and so are of importance in the management of the sick. This has been known and recorded for at least 30 centuries. I doubt whether any reasonable person will dispute the contention that emotional factors may aggravate certain diseases or even uncover the presence of an organic lesion not previously recognized. But the modern proponents of this ancient practice have no more conclusively established today that psychic factors are the cause of any disease than their predecessors did 5,000 years ago. Most of their claims in this direction are dubious, if not palpably false. The "evidence" they offer is obtained usually from the psychiatric examination of a few small groups of individuals suffering from certain organic dysfunctions. In examining the results of such studies and considering the contention that there is a specific etiologic relationship between psychic factors and permanent structural alteration, it is necessary to bear in mind that the only thing that is factually established is that among a small portion of individuals suffering from some disease some neurotics can be found. A number of relevant questions appear always to be ignored or unanswered. For instance, just to mention a few: Are the neurotic trends absent or do they occur less frequently in those who do not suffer from the disability? What is the actual incidence of the disease under study among the distinctly neurotic members of the general population? How about the possible effect of the disease itself in causing neurosis? Are conflicts symptoms or causes of a neurosis?

Altschule believes that the widespread distrust of quantitative data among psychiatrists is due to the fact that they have a natural abhorrence for precise methods of study because the data they are concerned with cannot be treated quantitatively without causing error. Maybe so. However, it is difficult to avoid the suspicion that psychiatrists will not face up to these questions because of a strange and disturbing fear among them that if they do they would be put away by their families. Whatever may be the reason, the results show that in drawing their conclusions they remain completely immune to objective facts. Hence we are continually bombarded with nonsensical studies "demonstrating" the causal relation of the personality with the ulcer, the emotions with essential hypertension, or heartbreak with housemaid's knee.

But what has this bombast got to do with Altschule's monograph? Surely, he did not write such things! Of course not, for around Boston it is said that he is a gentleman and a scholar—notwithstanding the fact that he is also an internist. His monograph is only 200 pages long, and into those pages he has compressed with most excellent organization almost 2400 references, still leaving room for such comment as might be pertinent to his thesis. As an example:

> "Human nature being what it is, it is not surprising that a system of thought as undisciplined as psychiatry should often follow the quick short way of flights of imagination rather than the long, difficult road of observation in exploring the jungle of mental disorder. . . . A thoroughly sound psychiatry cannot develop until all men working in it take it for granted that the accumulation of valid data is of primary importance and that exclusive preoccupation with superficially acceptable conclusions is deleterious. Informed ignorance is to be preferred to misguided certainty."

It saddens me to know that those for whom this work is intended will ignore it. I am sure that it will serve as an excellent source of references, as well as a

trail-blazer for the more critical, curious, and dissatisfied workers, if it should so happen that such individuals wander accidentally into this jungle. The author states that this book was not intended as an internist's revenge on psychiatrists. I should like it distinctly understood that I, too, am not a prejudiced anti-psychiatrist. Some of my best friends are psychiatrists. As a matter of fact, I am going to send a copy of this book to one of them next Christmas.

DAVID B. TYLER

THE PSYCHOSOMATIC CONCEPT IN PSYCHOANALYSIS. *Monogr. Ser. Boston Psychoanalytic Soc. & Inst., No. 1. Edited by Felix Deutsch. International Universities Press, New York.* $4.00. viii + 182 pp. 1953.

The Boston Psychoanalytic Society held a symposium on Feb. 9–10, 1952, to explore the "scientific status of the psychosomatic concept within the framework of psychoanalysis" under the following subtitles: Genetic and Dynamic Psychophysiological Determinants of Pathophysiological Processes (Sidney G. Margolin); Some Current Trends and Hypotheses of Psychosomatic Research (Roy R. Grinker); The Problem of Specificity in the Psychosomatic Process (Lawrence S. Kubie); Genesis of Psychosomatic Symptoms in Infancy—The Influence of Infantile Traumata upon Symptom Choice (Margaret W. Gerard); and Problems of Therapy (M. Ralph Kaufman). These papers and the discussion which followed have been published in this thin volume. Although Felix Deutsch, the editor, had expected the core of the discussion to deal with problems of "the specificity of the psychosomatic process" and of "the choice of the organ," this stimulating symposium surveyed a much wider field.

This is a vitally important subject in which no little confusion exists, and any attempt to achieve a comprehensive clarification constitutes an ambitious project that merits our welcome support. It is regrettable that much of the language of leading psychoanalytic thinkers continues to be almost incomprehensible to psychiatric workers not specifically trained in current orthodox psychoanalytic jargon or its esoterically styled formulations. It seems that American psychoanalysts should be able to express their concepts (however deep) in language that is simpler and clearer and less liable to misrepresentation. An improvement in this direction is discernible here and there, but a more conscious awareness of this isolationist and exclusive tendency (incidentally, singularly absent in Freud's own writings) could do much to bridge the still too great gap between psychoanalysis, on the one hand, and psychiatry and the social sciences, on the other. A common language would greatly facilitate the rate and depth of communication.

The theoretical presentations of Margolin and Grinker are outstanding. The former, after carefully dissecting the genetic and dynamic factors of the pathophysiologic process, concludes that "each psychosomatic manifestation can have several levels of organic and psychological regression with significant differences in prognosis and therapy." Grinker, who as Director of the (Michael Reese) Institute for Psychosomatic and Psychiatric Research has had the opportunity to study the theoretical and clinical aspects of psychosomatic medicine, finds most of the work in this field limited or distorted in perspective and approach. He offers valuable concepts in the area of theoretical clarification as well as in the direction of future research. The material in these 2 papers overlaps to a considerable extent, yet the literary styles and theoretical formulations of the two writers are sufficiently original and unique to remove any sense of unnecessary duplication.

Margaret Gerard's report on the origin of psychosomatic symptoms in infancy and childhood is largely based on her pioneering correlation study between symptoms and the child-mother relationship. She sees in maternal attitudes and behavior the prime traumatogenic factors. She suggests that "the incapacity for adequate functioning and susceptibility to breakdown of an organ may stem from the injury of the organ induced by the mother's care of the child during the physiological functioning of that organ."

Kubie's discussion of the question of psychosomatic specificity emphasizes what had already been enunciated by Grinker and Margolin, namely, "that we are unlikely to find specific factors for specific types of psychosomatic dysfunction" and that specific personality types or personality profiles cannot be correlated with constant psychosomatic syndromes.

In the final paper of the symposium, Kaufman presents a brief but valuable review of the theory of psychoanalytic therapy in general, citing the principal contributions of Freud and others, and lastly describes Margolin's anaclitic therapy of seriously ill psychosomatic patients (at Mt. Sinai Hospital, New York).

An invaluable portion of the symposium is comprised of the discussion of the above papers. Hendrick, Bandler, Bibring, Dawes, Deutsch, Jessner, Michaels, Murphy, and Zetzel all had meaningful things to say by way of clarification and emphasis, and posed significant questions for future elucidation and research. One closes this book with a feeling that an important milestone in the growth of psychoanalytic science has been recorded.

MEYER STEINBACH

PSYCHIATRY AND MEDICINE. *An Introduction to Personalized Medicine.*

By Leslie A. Osborn. McGraw-Hill Book Company,

New York, Toronto, and London. $7.50. xiv + 494 pp. 1952.

The author has written a quite unusual book approaching the subject of psychiatry from the standpoint of general medicine. He has produced a volume replete with cogent experience in the attitudes adopted toward sick people in general, the relationships of physician, family, and society to patients, patients' attitudes toward those about them, the inner dynamics of twisted thinking and feeling, and quite good summary statements concerning the special features of such feelings at all developmental periods of life. The psychiatric syndromes are discussed only casually and in relation to the more general topics noted above, and treatment follows the same pattern. Consequently, the medical student, for whom this book is principally intended, will find inadequate presentations of standard disease pictures and their treatment. In this sense, the reader is likely to come to the end of this volume with a very comfortable sense of what many would consider to be essential, but accessory, aspects of psychiatric practice and with inadequate preparation for the core of psychiatric material, namely, the knowledge of standard syndromes. The jacket emphasizes that this textbook will be useful for medical students throughout the four years of medical school, but I can only believe that the material here would have to be heavily supplemented by class demonstrations and readings in other textbooks in order for students to achieve from their psychiatric courses what is commonly expected of them. As an introduction to "personalized medicine," the book is very well done, informative, well written, and almost colloquial in presentation. There is a wealth of analogical material from the general medical and other fields scattered throughout the text—some pertinent, some distracting and more likely to be useful in a lecture than in a book.

Osborn rightly stresses that the core of psychiatric treatment is psychotherapy, but he gives what I would regard as only a grudging admission of the usefulness of the shock therapies, and he tends to take the position that the shock therapies are used in place of psychotherapy even to the point of suggesting that this is because the physician concerned is afraid to undergo the possibility of psychotherapeutic failure. I believe this to be an untenable position and an unfortunate slant on current problems of psychiatric treatment to leave with medical students.

WENDELL MUNCIE

STEPS IN PSYCHOTHERAPY. *Study of a Case of Sex-Fear Conflict. Institute of Human Relations, Yale University.*

By John Dollard, Frank Auld, Jr., and Alice Marsden White; Dael Wolfle, Editor. The Macmillan Company, New York. $3.50. x + 222 pp. 1953.

Steps in Psychotherapy is a logical product of the work of the Yale group of psychologists associated with the Institute for Human Relations. It is unfortunate, in view of the valuable contributions of this school, that these collaborative research projects are ending. This small, but practical and useful, book is based largely on the research and writing of Dollard and Miller and their coworkers in the field of learning theory.

These writers have been trying to achieve a functioning synthesis of psychoanalytic and learning theory and perhaps to reduce these principles to more scientific concepts couched in less jargon. Whether they will succeed in simplifying an admittedly complex subject or in adding anything vitally new or helpful to psychoanalytic theory remains to be seen, but it does seem to me that the Yale group has at least made a provocative, clear, and concise contribution to the ever controversial subject of brief psychotherapy.

This volume presents the essential portions (in transcript form) of 17 psychotherapeutic interviews hand in hand with supervisory comments. The format is attractive, and the supervision annotations are particularly instructive and interesting. There is a rather condensed introductory section dealing with the theoretical framework of the authors' approach; toward the end of the volume one finds quite a detailed discussion of the strategy and tactics employed in their technique.

One might regret the brevity of this project, and yet the authors may have been quite judicious to present so short but stimulating a book in so confused and disputatious a field. One may question the wisdom of the therapist playing such an active and aggressive role, although in skilled hands and in properly selected cases successful results may well be achieved. A note of caution, however, needs be emphasized for the young and inexperienced therapist who might seize upon this "bold" approach as a short-cut, with rather unhappy consequences. One could also wonder at the advisability of setting such definite goals in therapy to be achieved within a specified period (20 interviews). Notwithstanding these and other questions, I can personally only feel amply rewarded for the time spent in reading this book.

MEYER STEINBACH

THE ANNUAL SURVEY OF PSYCHOANALYSIS. *Volume I: 1950.*

Edited by John Frosch, in collaboration with Jacob A. Arlow, Nathaniel Ross, and Sidney Tarachow. International Universities Press, New York. $10.00. xvi + 556 pp. 1952.

This is a most unusual volume, the editors and the contributors making a comprehensive survey of current psychoanalytic theory and practice not only by abstracting all material of any real consequence pub-

lished in 1950, but further by weaving all together into a coherent whole under the following headings: history; critique; methodology; developmental studies; ego psychology; clinical studies; psychosomatic medicine; child analysis; psychoanalytic therapy; psychoanalysis applied in anthropology, religion, mythology, folk tales and folk ways, sociology, arts and aesthetics; psychoanalytic training and practice; and psychoanalytic books. The material has not only been carefully culled but is handled critically, the pros and cons of the controversial material from the current literature being represented.

This book is a time-saver for those of us who want to get the controversy into sharp focus, with all the material on it at hand at one time. It would be difficult to pick out the more exciting contributions, for this would depend upon the reader's interests. I found the historical material, along with the general critique of psychoanalysis and the critiques of specific concepts and of Freud's contributions, quite challenging. The chapter on applied psychoanalysis is also particularly interesting, especially that part dealing with anthropology and sociology.

This seems to be a very desirable survey. If subsequent volumes in the series are as good as the first, there should be no difficulty in assuring a wide circulation for them.

WENDELL MUNCIE

FOUNDATIONS OF NEUROPSYCHIATRY. *Fifth Revised and Enlarged Edition of the Work formerly known as A Preface to Nervous Disease.*

By Stanley Cobb. The Williams & Wilkins Company, Baltimore. $3.00. ix + 287 pp.; ill. 1952.

This fifth edition of the author's well-known book has been necessitated by advances in neurology and psychiatry. To numerous classes in the Harvard Medical School and to many of us in the field of psychiatry, this book with its several editions has been a constant and continuing provocation to clear thinking. The new edition is no exception. I know of no text which treats so succinctly and clearly the neurological basis of behavior, and which meets so successfully the "consciousness" and "mind-body" problems. Cobb states simply that there are three legitimate assumptions, namely, (1) "No biological process goes on without change of structure; (2) whenever the brain functions, there is organic change; and (3) the brain is the organ of mind." And concerning the consciousness, "Mind is the inter-relationship"—the relationship between all parts of the body mediated through the brain.

The final chapters, on Psychological Concepts in Medicine and Psychopathology, are excellent. It is good to see in such a chapter a number of telling paragraphs on Rate of Activity as an important element in personality function. Cobb points out that among 60 men from all branches of the arts and sciences, chosen to come to Harvard for its tercentenary celebration, there was every variation in body type, interests, and personal traits, but that, in common, they all possessed boundless energy. To try to describe this and to reach for its deeper meaning turns out to be a matter about which we know too little at this time, but to see it even mentioned in such a text is worthy of note. The author has some critical things to say concerning the term "unconscious" as it is loosely used, and calls our attention to the fact that the real translation of Freud's term is "unbeknown," and that consciousness actually is a matter of degree. Cobb notes that reflex arcs of the Pavlovian type do not form the basis of learning; the curves plotted for conditioning are not like those for other types of learning. His description of a developing personality is notable: "the primary endowment and the inborn reactions acted upon, modified, and conditioned by environment developed along certain lines by rewards and confirmed by satisfaction reactions."

The chapter on Psychopathology suffers, in my opinion, essentially and solely from one item, namely, lumping the manic-depressive and schizophrenic reactions together as schizo-affective reactions. Cobb's apology for this is that these reactions are all "functional," that is to say, with some unknown organic basis although, as he says, they are the ones best known to be heritable, and secondly, that they constitute the polarities in a spectrum with every variety in between. This is a well-known argument which, however, might be extended to include also the neuroses, even epileptiform and brain concussion syndromes, and other organic pictures. I see no merit in thus lumping together reactions which, by and large, are quite different.

This book is well written, and contains a wealth of real experience stated with all the humility of a master in his field. One may only hope that this text will survive many more revisions and become the *vade mecum* of countless more medical students.

WENDELL MUNCIE

ACCELERATED CONDUCTION: *The Wolff-Parkinson-White Syndrome and Related Conditions. Modern Medical Monographs.*

By Myron Prinzmetal, Rexford Kennamer, Eliot Corday, John A. Osborne, Joshua Fields, and L. Allen Smith. Grune & Stratton, New York. $4.00. viii + 110 pp. + 1 pl.; ill. 1952.

This well printed and abundantly illustrated short

monograph deals principally with the WPW syndrome, its identification, its origin, and its experimental production. Electrocardiographic and cinematographic techniques were employed rather exclusively in this study. It was concluded that the impulses in the WPW complex traverse the normal conduction pathway and that the phenomenon is not dependent upon anomalous auriculoventricular connections. The WPW syndrome is a congenital accelerated conduction syndrome as generally seen clinically. A classification is given of the numerous and diverse clinical types of accelerated cardiac conduction. The WPW syndrome is probably due to congenital abnormality of the auriculoventricular node. It is associated with nodal tachycardia and other supraventricular arrhythmias. The treatise closes with a summary and statement of conclusions and an appendix dealing with WPW complexes observed to occur during cardiac catheterization.

CHANDLER MCC. BROOKS

ALCOHOL EDUCATION. *A Guide-book for Teachers. By Joseph Hirsh, with the assistance of Selma G. Hirsh. Henry Schuman, New York.* $2.50. 107 pp. 1952.

Intended as a guide-book for teachers and school administrators, this compact volume (90 pages) serves as a skeleton guide around which a fair course might be constructed. The most useful section of the book is probably the bibliography, which gives a fairly well screened but incomplete cross-sectional list of references. Since some of these carry more extensive references, this would enable an educator to find his way around in the literature. The text gives a sketchy review of almost all aspects of the problem and should serve its purpose well.

LAWRENCE F. WOOLLEY

ANNUAL EPIDEMIOLOGICAL AND VITAL STATISTICS 1947–1949. *Part 1. Vital Statistics and Causes of Death.*

Prepared by the Division of Health Statistics. Organisation Mondiale de la Santé (World Health Organization), Geneva. $10.00. 746 pp. 1952.

This indispensable reference work, compiled by the World Health Organization, is a continuation of the *Rapports epidemiologiques annuels* formerly produced by the League of Nations. Its main parts are concerned with mortality and natality and with the causes of death. It has also a useful summary of life tables. Data on Russia and China are the most notable omissions from the general tables, while causes of death according to sex are available, in uneven quality, for only 38 countries, and those according to age as well as sex for only 35. The classification of causes of death is still that of the 1938 revision, except for the U. S. A. and South Africa for 1949, which use the 1948 revised list. The latter may be expected in future volumes rapidly to replace the former. A detailed study of the comparability of the two classifications is promised for the next volume.

Notwithstanding the limitations of the data on causes of death, which are open to wide margins of error in diagnosis, this volume is increasingly important, not only to public health students but also to a variety of medical research workers, especially to those studying the possible influences of different habits of life and types of consumption on the incidence of certain diseases. Since the work runs to 746 pages, it would be presumptuous to suggest additions, but it may be noted that deaths according to occupation are not included.

E. F. PENROSE

PSYCHOLOGY AND ANIMAL BEHAVIOR

THE SENSORY ORDER. *An Inquiry into the Foundations of Theoretical Psychology. By F. A. Hayek; with an Introduction by Heinrich Klüver. The University of Chicago Press, Chicago.* $5.00. xxii + 209 pp. 1952.

It is very startling to realize that this complex intellectual adventure into the treacherous jungle of theoretical psychobiology is the creative product of an economist. Someday, perhaps, this sort of thing will not be so surprising, but it is far from usual in the America of today to encounter the unique results of a combination of intelligence, imagination, creative ability, and breadth of education. That such combinations are so rare may be the primary reason why both the creative and publicational aspects of theoretical biology have suffered so in this country. Thus, it is most gratifying to find in Hayek's book a most encouraging example of a sustained attempt to bring together information, inference, and hypothesis in the several fields of biology, psychology, and philosophy. This sort of attempt can only be successfully carried out by a well trained scientific mind extremely well informed and flexible enough to see clearly across the "boundaries" between different fields of thought. As Hayek states, "... it was concern with the logical character of social theory which forced me to re-examine systematically my ideas on theoretical psychology."

The aim of the work is to employ current psy-

chological theories in an attempt "to work out certain implications of generally accepted facts or assumptions in order to use them as an explanation of the central problem of the nature of mental phenomena." Needless to say, the author realizes the impossibility of any one person's possessing all the qualifications necessary to accomplish this task completely. He feels that he is stressing a theory the physiological details of which were presented in Hebb's recent work on the *Organization of Behaviour*. Hayek's book presents an analysis of the sensory order in relation to the problems of theoretical psychology—a sensory order, part of which is the classification of events according to their sensory properties. Thus sensory perception is regarded as an act of classification—we perceive "properties which objects have in common with other objects." Qualities attributed to various objects are said not to be real properties, but "a set of relations by which our nervous system classifies them." As summarized by Klüver in his most admirable introduction, "Every sensation . . . must therefore be regarded as an interpretation of an event in the light of the past experience of the individual or the species. Experience operates on physiological events and arranges them into a structure or order which becomes the basis of their 'mental' significance." From this point it is not far to approximate definitions of mind and mental phenomena (abstraction, thought, discrimination, learning, etc.) in terms of this particular frame of reference—the classification process which operates in creating the sensory order. That such a classification is closely related to the topological problems of structural connections in the nervous system is of great interest and significance. Mind, to Hayek, is "a particular order of a set of events taking place in some organism and in some manner related to, but not identical with, the physical order of events in the environment." There is a remarkable similarity here to some of the other most recent definitions of mind stated by Eccles (Mental phenomena are facts of experience), Russell (Whatever we know without inference is mental) and Sherrington (Our mental experience is not open to observation through any sense organ). Perhaps we have entered upon a new era of agreement in the long series of attempts made by man throughout history to understand and analyze the concept of mind.

It is impossible here to go into detail concerning the remarkable interweaving of various data used by Hayek in his exposition, or into the possibilities it presents. Much of the discussion will be most important in future analysis of brain function and behavior. It is a fine theoretical treatise, well conceived, well thought out, and well written. It should be read carefully by all those interested in behavior at any level.

R. G. GRENELL

PSYCHOLOGY.

By Ross Stagner and T. F. Karwoski. McGraw-Hill Book Company, New York, Toronto, and London. $5.50. xiv + 582 pp.; ill. 1952.

This book in introductory psychology is divided into three parts, entitled respectively: Dynamics; Cognition; and Personality. Part I is preceded by a 30-page Orientation, which covers a variety of topics, including the history of psychology, scientific method, frames of reference, etc., and is as a result quite confusing.

The authors label themselves as functionalists and use homeostasis as the overall explanatory principle of behavior. The style of the book is simple and lively; and its attractive format and the abundance of good illustrations should make it pleasant reading for the beginning student of psychology. The effort to fit all behavior into the homeostatic principle occasionally produces a strain at the seams; but the advantage gained in giving the student an integrated picture of psychology partially compensates for this.

The book suffers from several weaknesses. There are some glaring gaps in content. Psychophysics is allotted less than 2 pages; an equal amount of space is devoted to abnormal behavior. No mention is made of statistical procedures utilized by the psychologist; and there is no organized discussion of the nervous system. The authors are aware of this last omission and offer the following explanation:

"Our attitude toward brain patterns is considerably like that of the physicist toward the electron. Nobody has ever seen an electron, but it is a convenient assumption to explain certain experimental effects which can be seen or recorded. In the same way, we find it expedient to assume that certain brain phenomena exist, because they provide a much needed link between series of observations." (p. 20).

Apparently the authors do not consider that physiological psychology is a branch of psychology, and in fact do not mention it in their Orientation. Nonetheless, the authors do on many occasions refer to the central nervous system as the need arises; but for beginning students this is likely to result in a confusing picture.

The authors are not particularly careful in their formulations, as the following examples will illustrate:

"Naturally, we want no one-sided concern with dynamics to the exclusion of knowledge" (p. 8). (Could they be referring to cognitive processes instead of knowledge?)

"What we ordinarily call the brain, since it makes up such a large portion of the total, is the cerebrum" (p. 152). A paragraph lower we find the thalamus included as part of the cerebrum!

". . . the psychotic has repressed his troubles so deeply that they no longer bother him" (p. 541). No one who has ever been in a ward of psychotics could say this.

This demonstrable lack of care sometimes results in statements that contradict each other. Thus, on p. 71 we are told that "many children reach a fairly advanced age before encountering situations setting off fear"; but on p. 99 we find that "Every child must learn to walk and in the process he is likely to have some painful bumps. Thus he may develop a realistic fear of loss of balance, lack of bodily support, and so on. The common fear of high places no doubt reflects these experiences of *early* [italics added] childhood."

The universal application of homeostasis as the explanatory principle results in a formulary treatment of many problems. Beginning students might have acquired a better appreciation of scientific psychology if some of the problems had been left unsolved or if alternate explanations had been offered.

SONIA F. OSLER

GENERAL PRINCIPLES OF PSYCHOLOGY.
By Frederick E. Eastburg. Bruce Humphries, Boston. $3.00. 168 pp.; ill. 1953.

This little book is a textbook for psychology students. It claims to derive its inspiration largely from the work of William McDougall. The author postulates, therefore, that instincts and emotions are deeply rooted and explanatory of both conscious and bodily activity. The author maintains that "psychology deals predominantly with such mental operations as interest, tension, perception, judgment, reason, and others of similar order." Consequently physiological aspects are treated cursorily. The material of the text deals in short order with these mental operations, leaning on the laws of association, reflex development, instincts and emotions. This is the best part of the book. The introduction, which purports to give a general review of the various approaches to psychology—behavioristic and introspective and purposive—is too brief to be really helpful, and the final chapters on psychiatry and psychoanalysis are wholly inadequate, if not misleading.

As a whole the text is quite disappointing. I find it hard to believe that college psychology students could be satisfied by such a presentation of this material and the actually puerile way in which it is written. As a sample of the confused thinking in this book the following will serve:

"Because of the interplay of qualities in the human individual and the intricate problem of graphing them into a unified personality, the psychoanalyst has been greatly baffled, and has been led into the field of psychiatry, where he has felt that his endeavors would be more fruitful. Men have achieved gigantic feats in the material world, but they have not become engineers of themselves as masterpieces of incomparable architecture."

Throughout the text there is overt adherence to the pursuit of "worthy goals" as the essential index to personality study, as the following paragraph indicates:

"Hence, a person who changes his purpose from time to time is like a house divided against itself, inasmuch as a continued adherence to some cherished ideal is an index to the self of the human individual. It is the pursuance of a worthy goal, which one entertains throughout life, that determines his true self and that is a criterion of personal existence."

The reduction of the personality to the conative tendency is highly debatable, and to compound this difficulty with the use of the term "worthy," not further defined, is to be deplored. From the standpoint of corrective psychology, namely, psychoanalysis and psychiatry, the book would have been better if no reference had been made to it at all.

WENDELL MUNCIE

PSYCHOLOGICAL STUDIES OF HUMAN DEVELOPMENT.
Edited by Raymond G. Kuhlen and George G. Thompson. Appleton-Century-Crofts, New York. $3.50. xiii + 533 pp.; ill. 1952.

This is a compendium of primary source materials. Seventy-one selected papers, somewhat adapted and abridged, have been grouped into sections as follows: Physical Factors in Psychological Development; Processes of Learning and Adjustment; Psychological Growth under Different Social-Cultural Conditions; Intellectual Changes with Age; Intelligence and Psychological Adjustment; Patterns of Language-Conceptual Growth; Interest Patterns and their Implications; Growth of Social Values and Attitudes; Social Development: Interpersonal Relations; Home and Family Relations; Adjustments in School; Vocational Orientation and Adjustment; and Some Factors in Personal and Emotional Adjustment. Each selection is preceded by a few words of introduction indicating to the student why the choice was made and what he should attempt to derive from the study of the source material. The authors represented include just about all the well-known workers in the field of developmental psychology. An adequate index is provided.

No one will be likely to question the great value to the student of a source-book of this kind. One question may, however, be raised. Would the *full* publication of a smaller number of papers be even better? Is there some danger of losing, if not essential facts and conclusions, at least some of the flavor and the full point of view of those authors whose work is thus abridged and adapted? It is much easier to ask this question than to answer it.

TWINS. *A Study of Three Pairs of Identical Twins, with 30 Charts.*

By Dorothy Burlingham. International Universities Press, New York. $7.50. x + 94 pp. + 30 folded charts. 1952.

This book may have considerable interest for students of the development of behavior, but as a genetic study it appears valueless, not only because it is based on so few pairs of twins but primarily because no evidence whatsoever is presented to show that the twins were in fact monozygotic. The book presents voluminous details about the twins' developing behavior and their influence on one another.

BENTLEY GLASS

THE MAKING OF A SCIENTIST.

By Anne Roe. Dodd, Mead & Company, New York. $3.75. xii + 244 pp. + 1 pl.; text ill. 1953.

A PSYCHOLOGICAL STUDY OF EMINENT BIOLOGISTS. *Psychol. Monogr., Vol. 65, No. 14.*

By Anne Roe. The American Psychological Association, Washington. $2.00 (paper). iii + 68 pp.; ill. 1952.

The aim of the study reported in this book was to discover "what kind of person the scientist is and why and how he becomes a scientist." The subjects were 64 men eminent in the fields of biology, physics, anthropology, and psychology. The method of investigation consisted of clinical interviews and the administration of several psychological tests. The tests yielded information about the subjects' intellectual capacity and personality structure. No control group was used, except that one of the tests, the Rorschach, was administered to a group of other scientists.

Though the primary object of the study was to discover what differentiates the scientist from the non-scientist, we get meager data on this point. We are told that: (1) these eminent scientists are very intelligent, much above the average person; (2) their fathers in more than half the cases were professional men and in the other cases were business men or farmers; (3) more of them were the first children born to their parents than would be expected from a sample selected at random; and (4) more biologists lost one parent at a young age than is normally the case.

Much space is devoted to intergroup comparisons of the five fields (the author subdivides physics into theoretical and experimental). But the conclusions reached do not rise above the obvious. We learn, for example, that social scientists show greater concern for people than do physical scientists; that physicists show greater concern with spatial relations than do biologists, and that they tend to think in terms of visual imagery, such as diagrams, to a greater extent than anthropologists.

It is, indeed, regrettable that such a fascinating research problem should have yielded so little in terms of meaningful data. Much of this may be attributed to the lack of any working hypotheses with which the author seems to have approached the problem. Apparently, this was to be a study in which a variety of material would be gathered and then scrutinized for emerging patterns. Such a procedure has the weakness of permitting the research worker to capitalize on chance differences, which may be considerable when so few subjects are involved. The fruitlessness of a random search of this type is enhanced by the fact that psychologists have not yet reached the point of being able to isolate the relevant variables in personality development, much less to make the more refined differentiations on the basis of vocational interests.

Triviality is not the greatest weakness of this book, however. The author, a clinical psychologist, inexcusably falls into the trap of confusing high motivation with neurosis. She engages in some hedging on the subject, but her words reveal how she tends to link eminence with neuroticism.

"That this particular group worked so hard, and has continued to work hard, is strong testimony to the degree of satisfaction they are getting from their activities. Is it, then, the case that to achieve greatly one must be neurotically driven? So far as I can see, while many of these men have greater than the usual insecurities, this is not true of all of them. I will go further and say that I do not see that it need be true. I am sure it is possible for a normally healthy man to become a great scientist,—after all some of these men cannot be otherwise described. But I think it may be harder, in some ways, most particularly in maintaining the degree of concentration needed." (p. 237).

We do not have any information as to how the author decided that her subjects had greater than the usual insecurities. We do know that this decision was not made on the basis of a comparison with an appropriate control group. The crux of her argument rests upon the high degree of drive and concentration exhibited by these eminent men. One cannot go into a systematic refutation of this point, as this is beyond the scope of a review; but one may simply point to the findings of a psychologist eminently qualified to speak on this subject: Terman, who has worked over a period of decades on the subject of genius. Contrary to the notion of genius being peculiar, socially inept, and generally maladjusted, he finds that his gifted subjects were stable, well balanced, and free from excessive conflicts and frustrations. From other discussions in the book it is apparent that Miss Roe does know the difference between high motivation and neurotic motivation; yet at this point she certainly confuses the two. This is particularly regrettable in a book addressed to a lay audience, where much misconception about genius already exists.

SONIA F. OSLER

THE RANGE OF HUMAN CAPACITIES. *Second Edition. By David Wechsler. Williams & Wilkins Company, Baltimore.* $4.00. x + 190 pp.; ill. 1952.

The present revision of this work is in response to a steady demand for the original edition, now long out of print. New material on age differences and differences in capacities related to productive work has been added, but the bulk of the subject matter remains unchanged. This is because, as the author notes, the past twenty years have seen relatively little fundamental work on individual differences. The author's original hypothesis concerning the constancy and limited magnitude of range of human abilities remains unchanged.

JAMES DEESE

METHOD AND THEORY IN EXPERIMENTAL PSYCHOLOGY. *By Charles E. Osgood. Oxford University Press, New York.* $14.00 (trade ed.); $10.00 (college ed.). viii + 800 pp.; ill. 1953.

The first word in the title of this book may be somewhat misleading, for this is a book featuring neither research techniques nor experimental design. It is the second noun that provides the key to the whole work. Individual questions and answers are of little scientific significance in disjointed isolation. They acquire real meaning only as they are related logically to larger segments of knowledge through the medium of *theory*. To accomplish this, Osgood's plan of attack within each of the four major areas covered (Sensory Processes, Perceptual Processes, Learning, and Symbolic Processes), is to state some of the broad problems that persistently occur, to outline the major theories relevant to these problems and to extend them to their logical limit, and to present the behavioral and physiological data that bear upon—and all too frequently embarrass—the theoretical positions. A less neat but perhaps more accurate title might have been "The Development, Rationale, and Assessment of Some Theories in Experimental Psychology."

The consequences of the author's strategy are several. (1) There is no compulsion to drag in every topic of traditional experimental psychology. If the detailed description of after-images is included, it is done not for the sake of a complete literature coverage, but only because the full evaluation of color vision theory demands it. (2) Particular investigations, and entire subareas, take on new importance and fresh interest as they are shown to be indivisibly part of a coherent story of behavior. Stated differently, the results of psychological experiments make more sense when embedded in a theoretical matrix than when rattling around in an empirical vacuum. (3) The critical gaps and the contradictions within our body of knowledge are starkly exposed. Points likely to be susceptible of fruitful attack are almost automatically indicated. (4) The cut-and-dry nature of science, the inevitable interpenetration of observation and logical interpretation, the eternally incomplete and fluid state of "fact" are demonstrated in persuasive fashion.

When one man sets himself the chore of assimilating and reformulating so much of experimental psychology (represented here by 1290 references), complete originality is impossible, if indeed desirable. Where he leans most heavily upon eminent authorities—e.g., on Granit in the chapter on vision—Osgood does not become lost in borrowing. Typically, he makes a more direct contribution, as when he tries to specify the postulates implicit in Tolman's and Kohler's work, or to develop on a Hullian base a "mediation hypothesis" to tie together many diverse aspects of performance.

For whom will this book be most valuable? It is clearly beyond the reach of the second-year university student in experimental psychology, and possibly of all undergraduates but the most dedicated and thoroughly grounded senior. Its integrative and synthesizing nature seems to fit it best to be a study guide for the graduate student who is becoming oriented in advanced work or is organizing his thoughts for the comprehensive examination. While coverage is as broad and detailed as in some so-called handbooks, the really serious scholar will feel the need for additional reading. It is a strong point of the book that adequate bibliographic help is given to satisfy this requirement.

FRANK W. FINGER

PERSONALITY THROUGH PERCEPTION. *An Experimental and Clinical Study. By H. A. Witkin, H. B. Lewis, M. Hertzman, K. Machover, P. Breinall Meissner, and S. Wapner. Harper & Brothers, New York.* $7.50. xxvi + 572 pp.; ill. 1954.

This is a detailed report of a systematic 10-year study of the implications of certain broad differences in individual perception for an increased understanding of personality. Starting from experimental explorations into the bases of human judgments of upright position, a relentless search for the correlates of individual differences in "perceptual style" led Witkin and his associates into ramified studies of other important personality differences.

Three situations were used to determine individual differences in the use of cues upon which judgments of upright position may be based: a movable luminous rod surrounded by a luminous frame of adjustable tilt in a darkened room; a room of adjustable tilt in which the subject was seated on a chair of adjustable tilt; and the same tilting-room tilting-chair arrangement rotated on a track. When observed under the systematically varied conditions of these settings, subjects showed a wide range of differences in ability to adjust the rod, their chair, or the tilted room itself to the

upright position. Analysis of the subjects' performances showed that these differences could be derived from subjects' contrasting emphases on the immediate visual frame of reference or, on the other hand, their own bodily sensations of position. The former subjects were referred to as "field-dependent," the latter as "analytical," "independent," or sometimes "field-resistant." The reported studies of this dichotomous variable deal with the consistency of such individual perceptual styles, the relationships of such individual styles to other personality characteristics, and to personality changes occurring in children between 8 and 17 years of age.

The findings concerning relationships between "field-dependence" and "field-resistance" and the other personality features derived from many kinds of interview and projective data were that: "... field-dependent persons tend to be characterized by passivity in dealing with the environment; by unfamiliarity with and fear of their own impulses, together with poor control over them; by lack of self-esteem; and by the possession of a relatively primitive, undifferentiated body image. Independent or analytical perceptual performers, in contrast, tend to be characterized by activity and independence in relation to the environment; by closer communication with, and better control of, their own impulses; and by relatively high self-esteem and a more differentiated mature body image. These are the relationships that were revealed in our intensive study of a group of young, normal adults, and confirmed in studies of children and of hospitalized psychiatric patients" (p. 469). It is necessary, however, to read the authors' full discussion of these findings to avoid misunderstanding and oversimplification. For example, they are careful to point out that "the particular characteristics we have found to be relevant to perceptual performance may occur in quite different total personality settings, or in association with various other characteristics, any of which may determine the predominant pattern of the individual's personality. Hence, even though the personality characteristics found in association with independent perceptual behavior are also apt to occur in more mature individuals, the relationship between field dependence and maturity is not a necessary or inevitable one" (p. 471). Another finding that should provoke discussion was that women were generally more field-dependent than men, made less use of their body sensations than men, and were more variable in their performance under different conditions. The writers have suggested that these differences are related to the biological, cultural, and social factors leading to greater basic passivity and acceptance of immediately given situations on the part of women. In the developmental facet of the study, there was clear evidence for decreasing average field-dependence with age, particularly between 10 and 13 years. This change was found to be a function of the marked increases of self-definition, control of impulses, and coping techniques during this period. At 15 years the field dependence of the girl subjects began to rise, while this same rise did not occur in the group of boys until 17 years. This difference appeared related to the explanation given for the differences mentioned for men and women.

This report of a major research project has several important implications. First, it shows the fruitfulness of following a problem wherever it seems to lead instead of remaining within the safe confines of a problem delimited by the use of exact but restricted observations of persons. Secondly, the authors have shown how experimental and clinical studies of personality can dovetail in a fruitful fashion, particularly when the precise findings of experiments are related to, and evaluated in, a context of the individual's other personality characteristics. Thirdly, they have shown how the apparent conceptual gap between a quasi-structural theory of personality, like that of classical psychoanalysis, and a Gestalt or field-type theory of personality, like that of Lewin, Werner, or Asch, can be reduced through the use and correlation of observations made within both conceptual frames of reference. A book so rich in indications and implications for personality theory and research deserves to be read carefully. It is to be hoped that such careful reading will prevent one more simple litmus-paper test of persons from being added to the long popular list beginning with "introvert" and "extravert" and ending with the glib use of "inner-directed person" or "other-directed person."

ERLING ENG

CULTURE AND PERSONALITY.

By John J. Honigmann. Harper & Bros., New York. $5.00. x + 500 pp. 1954.

In the early 1930's a new field of human study took formal shape in this country: the study of culture and personality. Although it had many antecedents, it emerged most immediately from the anthropologists' discovery of the value of psychoanalytic approaches and findings for understanding the familial origins of personality, as well as the implications of personality structures and dynamics for culture. Gradually the study of these relationships influenced, and was influenced by, the socially and culturally sensitive psychoanalytic views of Fromm, Horney, and H. S. Sullivan. World War II, with its government support and encouragement of culture studies, marked the "arrival" of the "personality-in-culture" within the larger orbit of cultural or social anthropology. However, students in the new culture and personality courses after the war had to do most of their reading in journals once they had covered the standard references of Mead, Benedict, Kardiner, and Linton. This situation was soon remedied with the appearance of such collections

of writings as Kluckhohn and Murray's *Personality in Nature, Culture, and Society* and Haring's *Personal Character and Cultural Milieu*.

Honigmann's new book is the first textbook to be sharply focussed on the study of personality and culture. He has had unusual success in throwing an all-encompassing net about this many-headed discipline, so that it may be carefully observed and understood by the student. The coverage of the book is extremely broad and free of one-sided commitments to any particular approach. The author has encouraged "open-endedness" in the reader's thinking throughout the book and has, in addition, provided thoughtfully annotated "suggestions for further reading" at the end of each chapter. Especially notable is the way in which the author keeps the reader aware of the ways in which concepts are derived from empirical data. His skill in showing how various kinds of cultural patterning can be delineated with scientific objectivity should be a pleasure for the critical reader. Honigmann's clear and comprehensive text is recommended to all who are curious about how "what a person is like" is complexly expressive of "the culture in which he lives."

ERLING ENG

THE LOVE AND FEAR OF FLYING.

By Douglas D. Bond; preface by General James H. Doolittle. International Universities Press, New York. $3.25. 190 pp. 1952.

This most interesting book arises out of the author's experience in the Air Corps during World War II, particularly his work with the 8th Air Force, stationed in England. It has to do with the psychological basis for the love of flying, and the psychological problems present in those flyers who become unable to fly for emotional reasons. The author links the love of flying to the expression of aggressive tendencies and also to libidinal tendencies. He notes that many fanatic flyers put flying first and women second in their lives. In the American Air Force intense hatred of the enemy as a prominent component in the desire to fly and in the expression of aggressive tendencies was mostly absent.

Difficulties in flying were mostly of a phobic sort and could be complete or partial. In the latter case it would take the form of being unable to fly under certain conditions. These phobic reactions largely developed as a consequence of battle experience and were closely related in frequency to the frequency of loss of planes and personnel through combat experience. While the rational elements in this argument are not to be denied, the import of the phobia on the individual victim, however, was always linked with material from his past. In short, the patient became concerned about inner conflicts rather than outer conflicts. Guilt feelings concerning the death of comrades about whom one had entertained ambivalent feelings were prominent in such conditions. This not infrequently led to disguised suicidal drives manifested in dangerous flying, a point that sometimes was not sufficiently appreciated. In the phobia where this type of guilt was important, the open expression of aggressive feelings toward the object was an important element in treatment.

As it turns out, most of the victims of this phobia were finally able to return only to partial duty; that is to say, they were grounded or transferred to some other kind of flying where the type of feared combat experience would not have to be encountered. This led to administrative difficulties, because often the grounded flyer advanced more rapidly in rank than the flyer who was kept in active service. The author relates in detail the tug-of-war between the administrative view of such neurotic problems and the medical view, and points up the real "hot spot" on which the psychiatrist found himself when attempting to deal scientifically with this issue. One thing comes out with startling clarity, namely, that no sure-fire way is at hand, psychiatrically speaking, for the quick relief and cure of such phobias. Administrative reassignment seems to have been an important adjunct of treatment, if not a sine qua non.

Tables show the extent of such problems in the 8th Air Force; and a Foreword by General Doolittle extols the activities of the 8th Air Force. The book is a very welcome addition to discussions of war neuroses. Incidentally, the author's experiences with pentothal interviews seem not to have the same decisive consequences of treatment that Brinker and Spiegel have reported from their North African experience.

WENDELL MUNCIE

CURRENT TRENDS—PSYCHOLOGY IN THE WORLD EMERGENCY.

By John C. Flanagan, et al. University of Pittsburgh Press, Pittsburgh. $4.00. x + 198 pp. 1952.

This volume reports the sixth annual set of lectures on "Current Trends in Psychology" sponsored by the University of Pittsburgh. Seven psychologists and one sociologist discuss various aspects of research problems and programs in the military services. All of the authors are prominently identified with these programs, five through full-time participation in them as regular employees of the Department of Defense. The different lectures vary considerably in depth and scope, from simple factual accounts of governmental research organization to thoughtful analyses of basic problems of military research. Certain important topics, e.g., human engineering research, receive relatively little attention. However, the volume as a whole gives a useful bird's-eye view of the current state of military psychology. This, one must assume, is in fact the objective of the lectures. They are not concerned, as the title might imply, to survey all psychological research relevant to

the world emergency, nor to assess more fundamentally the status of scientific psychology at this moment in history.

ROBERT L. FRENCH

APPRAISING PERSONALITY. *The Use of Psychological Tests in the Practice of Medicine.*

By Molly Harrower. W. W. Norton & Company, New York. $4.00. xviii + 198 pp.; ill. 1952.

This book, according to its subtitle, is written primarily for doctors and psychologists, but it will also be of interest to those in any other profession who need to know more about the people they work with in order to help them. It is divided into 3 parts, the first being an explanation of what a clinical psychologist does and the way in which he goes about it; the second, an examination of some of the most commonly used tests, such as the Rorschach inkblots, the Bellevue-Wechsler Intelligence Scale, figure drawings, etc.; and lastly, a section devoted to practical applications of the knowledge derived from such tests to several familiar medical problems.

The book is written largely in the form of a dialogue between the psychologist and the physician, with sufficient illustrations and simple charts to make clear what is being discussed. Harrower's lively didactic skill produces surprisingly well-sustained reader interest almost in spite of the form used; obscurities are very few and the examples chosen are sometimes brilliant. As having essentially avoided technical jargon, this introduction to the field of projective psychological testing can be unhesitatingly recommended. A brief reading list is appended, and there is an adequate index.

JEROME HARTZ

TOTEM AND TABOO. *Some Points of Agreement Between the Mental Lives of Savages and Neurotics.*

By Sigmund Freud; authorized translation by James Strachey. W. W. Norton & Company, New York. $3.00. xi + 172 pp. 1952.

One is likely to approach a rereading of this venture by Freud into the field of anthropology with some hesitancy and misgiving. Appearing more than 40 years ago, this work is not often read today except as a compulsory assignment for psychoanalytic trainees. One also wonders why a new translation had to appear at this late date.

However, any doubts are quickly dispelled. The significance, the freshness and pertinence (even for today) of Freud's study, the interesting manner of presentation, the clear and logical development of his argument and the beautiful style (so free of jargon and the esotericisms characteristic of much of Freud's latter-day followers) all contribute to a most instructive and stimulating literary experience. And one can quite appreciate James Strachey's desire to present to English readers a more faithful version of Freud's style. It can be fairly assumed that Anna Freud's collaboration gives to this translation a certain stamp of authenticity.

In the January issue of the *Journal of the American Analytic Association*, Ernst Kris pays a glowing tribute to James Strachey, under whose editorship, in collaboration with Anna Freud, the Standard Edition of the *Complete Psychological Works of Sigmund Freud* is being prepared. Referring to Strachey's version of *The Interpretation of Dreams*, Kris remarked that "it is indeed a fortunate coincidence that the erudition and psychoanalytic training of a translator is here combined with literary craftsmanship of high order and rigorous standards."

Totem and Taboo comprises 4 essays which first appeared in the *Viennese Imago* under the title *Some Aspects of Agreement between the Mental Lives of Savages and Neurotics*. In 1913 these articles were incorporated in a book under the present name; since then editions in various languages have appeared, although the English version by A. A. Brill has remained unaltered since 1918.

In the first article, on The Horror of Incest, Freud quotes numerous field workers and writers to illustrate the universality of the taboo against incestuous relationships among primitive peoples, not only in the same family but generally among members of the same totem clan.

The second essay, Taboo and Emotional Ambivalence, is a fascinating demonstration of the application of psychoanalytic concepts to a hither-to rather confused subject, with resultant order and clarification. Not only did Freud shed considerable light on many obscure aspects of the mental life of savages, but he also drew startling parallels to the thinking and unconscious processes of neurotics, especially those exhibiting obsessive compulsive behavior.

In the third chapter, Animism, Magic and the Omnipotence of Thoughts, Freud delved further into the mysteries of primitive thought and ritual, proving once more that psychoanalysis was not only a valuable tool in the investigation of the savage man, but also pointed the way to vitalize anthropologic science. It was a reading of these contributions that turned the eminent anthropologist Geza Roheim into the path of psychoanalysis and helped to open a revolutionary chapter in the development of modern dynamic anthropology. Of special interest is Freud's attempt to correlate the "three great systems of thought, animism, religion and science" with the developmental stages of man-narcissism, object choice (parent-child relationship), and maturity, respectively.

The last article, rather weakly and inadequately named The Return of Totemism in Childhood, is a fascinating study of the entire theoretical framework

of totemism and its relation to the incest taboo. After surveying the various hypotheses offered to explain the meaning and origin of totemism, Freud drew on the work of Robertson Smith, Atkinson, and Darwin for the construction of his "primal horde theory." This thesis, but especially its corollary concept of the "racial unconscious," has raised a storm of controversy and is today largely rejected by leading anthropologists, biologists, sociologists, and others. In my own inexpert opinion, neither the questionable scientific status of the idea of an archaic inheritance, nor the primal horde reconstruction of early societal organization, seriously affect the basic value of Freud's contribution. Whether the first primal father was actually murdered and devoured by his sons, who then in atonement for their crime created the totem custom and ritual and for the protection of their social structure agreed upon a state of exogamy, is perhaps actually immaterial. The central core of this book, namely, the universality of the Oedipus Drama, is not invalidated. It may well be that the perennial (conscious and unconscious) psychological conflicts with their patricidal and fratricidal potential have always nourished a suitable cultural matrix for the creation of "primal crime" fantasies; and it is perhaps as a defense against such a patricidal temptation that totemic rites were instituted (see S. S. Feldman's *Notes on the Primal Horde-Psychoanalysis and The Social Sciences*, Vol. 1., pp. 171–193). In either case the theory of the racial unconscious is not an indispensable corollary to the above thesis. It is of interest historically and is rather ironic that Geza Roheim, who won the Freud Prize in 1921 for his article on Australian Totemism and whose expedition was then arranged by Freud and Ferenczi and generously financed by Princess Marie Bonaparte, returned from his extensive field work convinced of the lack of sufficient evidence for the primal horde theory. The remainder of the article presents interesting examples of totemism in children and cites many rites in classic and mythologic literature.

If I find any fault with Strachey's editorship, it lies in his neglect to indicate the present status of Freud's primal horde theory, for uninformed but worshipful psychoanalytic neophytes (and even older Freudians) might readily "incorporate" it in toto as established anthropologic doctrine. The rejection or modification of these concepts in no way diminishes the significance and brilliance of Freud's *Totem and Taboo*.

MEYER STEINBACH

THE ORIGINS OF LOVE AND HATE.

By Ian D. Suttie; Introduction by Ashley Montagu. The Julian Press, New York. $4.00. x + 275 pp. 1952.

This first American edition of a book published in England in 1935 is an exact reprinting of what has come to be recognized as an outstanding critical, yet constructive, consideration of Freud's theories. Suttie emphasizes love in place of sex, the need for companionship in place of libido, and the significance of the mother in rearing the child, in place of the father. Many of Suttie's suggested hypotheses and "tentative formulations" have been verified by practicing psychoanalysts who have come more and more to recognize the inadequacies, errors, and biases contained in the revolutionary teachings of Freud.

SELECTED PAPERS.

By Ludwig Jekels; including two papers written in collaboration with Edmund Bergler. International Universities Press, New York. $4.50. iv + 201 pp. 1952.

This volume brings together, fortunately, a number of papers of the late Ludwig Jekels, most of them written alone, the last two of the series in collaboration with Edmund Bergler. They are analytic studies of various topics: the turning point in the life of Napoleon I; the sense of guilt; pity; comedy; the riddle of Macbeth; duplicated expression of psychic themes in dreams; psychology of the festival of Christmas; instinct dualism in dreams; and transference and love.

For me, the most interesting chapter is the first one, which deals with the turning point in the life of Napoleon, that period when, within a short time, he turned from being an ardent Corsican patriot demanding freedom from French rule to an ardent Francophile seeing the entire future of Corsica, whenever he gave any thought to it at all, only in union with France. Jekels picked out this topic for discussion because, among the 80,000 references to Napoleon, there is no satisfactory explanation for this extraordinary change-over, even by Napoleon's great biographers. Jekels finds a satisfactory answer in a psychoanalytic interpretation of certain events of Napoleon's early life which continued to cast their shadow on him until his death. Briefly put, these facts are as follows: Napoleon's varying attitude toward Corsica and France were projections of his varying attitudes toward his mother and his father, and toward that other father-figure, Paoli, the great Corsican patriot. According to Jekels, there was every reason to believe that his father, a former adherent of Paoli, while going along with the ruling French Lieutenant-Governor, winked at intimacies between the latter and Napoleon's mother. Hence Napoleon's anger against the foreigners attacking Corsica; hence his idolatry of Paoli, the Corsican patriot. Yet a few years later, when the King of France, another father-figure, was beheaded, Napoleon made a rapid about-face and became a Francophile and worked for the incorporation of Corsica into France as a projection of his own incestuous wishes. This was accompanied by a changed attitude toward Paoli, who

was now reproached for working to prevent the union of Corsica and France. The death of the King taught Napoleon 'how perfidious fathers should be treated, and instituted in Napoleon the unsatiable desire to win the mother and tear her away from his father," a struggle which the author sees as one of the great epics in human history, and the motivation behind Napoleon's statement: "For I am not a man like others, and laws of morality and convention cannot be made for me."

Napoleon's subsequent relationship with women was one of complete disrespect, brutality, coldness, with only the one exception of his relationship to Josephine, who satisfied the requirements for his affections, namely, that she be older and promiscuous. These things furnish additional proof of the ambivalent attitude toward his mother and his incestuous wishes toward her. His self-glorification in attempting to take over the world becomes the consuming effort to satisfy his incestuous wishes, and to challenge to the utmost his father. What distinguishes Napoleon's career from that of an ordinary severe neurosis, which one might see in the consulting room, was that the times were ripe for acting out and partially sublimating these desires on the grand scale. Consequently, we see the course of history turned—and in many ways turned for the better—by a man who, under other circumstances, might have come to a very different fate.

The subsequent chapters of the series are neat essays on specific topics, each with its own interest. Of special interest is the assertion of the significance of superego factors in dreams, an item put forward as a challenge to older theories about dreams.

WENDELL MUNCIE

THE PSYCHOLOGY AND PSYCHOTHERAPY OF OTTO RANK. *An Historical and Comparative Introduction.* *By Fay B. Karpf. Philosophical Library, New York.* $3.00. xii + 129 pp. + 3 pl. 1953.

This little volume, by an associate of Otto Rank, is a most welcome presentation, for the English-speaking reader, of the fundamental aspects of Rank's psychology and attitude to therapy. The author starts out with an account of Rank's position in the original group around Freud, the background of his interests in creative artistry and cultural phenomena, and his gradual deviation from strict Freudian orthodoxy. From these two aspects of his interest in artistic creativity phenomena there apparently arose the two principal aspects of his deviation from the psychoanalytic dogma. As to the first, Rank apparently became dissatisfied with what he considered a mechanistic conception of human personality, particularly with all views of the ego as a victim of the squeeze between the id and an externally imposed super-ego. This seemed to Rank to be an utter denial of that which most characterizes the human personality, namely, its capacity for creative expression; and out of this dissatisfaction grew his extended presentation of the "will" psychology. This "will" psychology essentially an ego psychology, differed from Adler's in that it did not rest on an effort to triumph over biological inadequacy, but regarded such creativity as actually the expression of that vital force, whatever it be called, libido, sexuality, or whatnot.

Rank's break with the Freudian group was formalized with his publication on the birth trauma. This was essentially also culturally determined, he held, and led him to deny the primacy of the Oedipus problem as the prototype of anxiety, and to rest the case upon the separation from the mother as the prototype. Psychologically, this meant a dethronement of the father in favor of the mother as the principal other element in human relationship, an attitude which one sees increasingly subscribed to currently. This interest in cultural phenomena determined Rank's whole concept of personality development as culturally determined rather than biologically determined—once again an important deviation from the original Freudian dogma, and an attitude which has many supporters today, perhaps an increasing number. The author points out that Rank's long years with the psychoanalytic movement and his attitude toward Freud and toward the movement, apparently served to prevent him from that open and frank break with psychoanalysis which Jung and Adler came to, and which perhaps made the full understanding of his contributions the more difficult, since he couched his conceptions in terms of psychoanalytic doctrine that asserted either an antithesis or similarity. It is rather interesting, and perhaps also a culturally based fact, that his views have gained a wider and more appreciative audience in America than in Europe, and have been eagerly accepted and propounded by services adjunct to psychiatry proper, namely, social service (represented by the Pennsylvania School), guidance, counseling, and so on.

The book may be said to be authoritative in that Rank himself had a good bit to do with writing the crucial chapters, and the material may be said to represent his views officially, since the book itself is only an expansion of introductory material offered by the author to a series of lectures given by Rank himself at the Jewish School For Social Work between 1935 and 1939, the date of his untimely death.

That Rank's interests have already proven a challenge to set Freudian conclusions cannot be doubted. Karpf cites Rank as no dogmatist, as offering his conclusions in tentative fashion for whatever they might be worth; and certainly this is the spirit of open inquiry very much needed in present-day psychology. Rank's view that there is not a single psychology but only multiple psychologies is a healthy one today.

WENDELL MUNCIE

HUMAN BIOLOGY

HUMAN LOCOMOTION AND BODY FORM. *A Study of Gravity and Man.*

By Dudley J. Morton, with the collaboration of Dudley Dean Fuller. The Williams & Wilkins Company, Baltimore. $5.00. xii + 285 pp.; ill. 1952.

According to Morton, a qualified anatomist, the appreciation of the human locomotor apparatus cannot be obtained by studies of morphology alone. He believes that it is necessary to use the physiologic as well as the anatomic approach. Indeed, to evolve his treatise he reaches into the fields of genetics, chemistry, clinical medicine, and engineering. The evolution of the locomotor system is traced via genetics from early forms of life, with particular attention to the influence of gravity. The role of Wolff's Law is emphasized in the description of structural changes that result from altered stresses. The author incorporates his own observations on the anatomy of the normal foot and its variations. His concepts on the part played by the short first metatarsal and the hypermobile first metatarsal segment in the production of foot ailments are presented in separate chapters. The controversial character of these ideas is brought out in another chapter in which he attacks the surgeons who conducted the Canadian Army Foot Survey for their article criticizing his thesis.

In spite of the interesting material included, the book is not one for light reading. The presentation of material from diverse scientific branches in their own technical verbiage may prove helpful to any reader who is fortunate enough to be trained in each of these fields. For many, a proper understanding of the contents will involve careful, deliberate study.

I. WILLIAM NACHLAS

THE HUMAN BLOOD GROUPS *Utilized in Disputed Paternity Cases and Criminal Proceedings.*

By P. H. Andresen. Charles C Thomas, Springfield, Ill. $3.75. viii + 114 pp. 1952.

THE RH BLOOD GROUPS AND THEIR CLINICAL EFFECTS. *Medical Research Council Memorandum No. 27 (Revision of Memorandum No. 19).*

By P. L. Mollison, A. E. Mourant, and R. R. Race. Her Majesty's Stationery Office, London. 3s. (paper). vi + 72 pp.; ill. 1952.

LE SYSTÈME SANGUIN RHESUS.

By Andrée Tétry. Albin Michel, Paris. 390 fr. (paper). 242 pp; ill. 1950.

These three publications deal with restricted aspects of the human blood groups. Andresen's slender volume will scarcely replace as a general reference the far more comprehensive work by Race and Sanger, *Blood Groups in Man*. It was of course not intended to. It is restricted largely to a consideration of the legal importance of blood groups in the identification of criminals and in the determination of disputed paternity. Interesting cases of these applications from the Danish courts are given, and it is evident that blood tests are accepted as evidence in that country perhaps more fully and freely than anywhere else. Andresen's discussion of known exceptions to the rules of hereditary transmission includes the Haselhorst case (mother AB; child O) and the Gammelgaard case, in which the A character was so weak that it was missed by routine blood tests and was only picked up in the subject's saliva. Yet nowhere in Andresen's discussion of medicolegal blood testing, nor in any other known to me, is the possibility of mutation considered. The lack of clear exceptions in a few thousand assembled cases means very little, because there has been a frank tendency in the past to attribute all exceptions to illegitimacy. Yet, if the blood group alleles have mutation rates comparable to those of other human genes, exceptions due to mutation might well occur at a probability level of 1 in 50,000 to 1 in 10,000, or maybe even higher. This question will never be satisfactorily settled until the same careful study of blood group exceptions is made that is regularly applied now in diagnosing monozygosity in twins. Proper use of blood tests for legal purposes should always demand exclusion on the basis of *multiple* characters. That is to say, before a man is excluded from paternity in a given case, it should be demonstrable that the child could not be his on the basis of at least *two* blood group systems. Until this is recognized, our legal practice is unsound.

The manual by Mollison, Mourant, and Race consists of 3 parts, each one written separately by one of the three authors. Race discusses the Rh groups and their inheritance very briefly. The major part of the bulletin is comprised of a consideration of the clinical effects of Rh incompatibility, by Mollison; and of the nature of the numerous and complicated types of Rh testing now employed, by Mourant. The latter section is most likely to be useful, as not being so fully or so clearly discussed elsewhere.

The book by A. Tétry, which came for review rather belatedly, is a clear and very well written account for the date (1950). Although recent advances in this very active field already necessitate a revision, there are several interesting sections dealing with aspects of the Rh groups that have been neglected by other authors. The chapter on medicolegal applications reveals France rather laggard in the acceptance of such evidence. A number of interesting cases are discussed. Particularly welcome is a chapter on the existence of conditions similar to human hemolytic disease in certain animals: the mules of Poitou, dogs, cats, rats and rabbits (experimentally induced), and the foals of horses. The book unfortunately has no index.

BENTLEY GLASS

SEXUAL BEHAVIOR IN THE HUMAN FEMALE.

By the Staff of the Institute for Sex Research, Indiana University: Alfred C. Kinsey, Wardell B. Pomeroy, Clyde E. Martin, and Paul H. Gebhard, Research Associates; Research Assistants, Jean M. Brown, Cornelia V. Christenson, Dorothy Collins, William Dellenback, Hedwig G. Leser, and Eleanor L. Roehr; Research Associates, Ritchie G. Davis and Alice W. Field; Special Translator, Henry H. Remak. W. B. Saunders Company, Philadelphia and London. $8.00. xxx + 842 pp.; ill. 1953.

Some understanding of the atmosphere on Mars, of the ultramicroscopic structure of the neuron, of the taxonomy of the Thysanoptera, and of hundreds of other recondite fields has now been achieved. Thought and imagination, skill and energy have released the secrets of distant lands and ancient times, of creatures too small to see without instruments and too bizarre to credit without photographs.

It was rather a shock, then, when A. C. Kinsey and his associates exposed our not so blissful ignorance regarding a major aspect of one of the two basic biological impulses of *Homo sapiens* himself. Worse, it became evident, with the publication of *Sexual Behavior in the Human Male*, that much of what man thought he knew about this subject was quaintly erroneous.

Sexual Behavior in the Human Female, the second of a projected series of volumes, reports the results of statistical studies of confidential case histories obtained from nearly six thousand white females in the United States. That the sample necessarily is limited and in some respects inadequate is conceded by the authors. That the study did not encompass the records of females of all races or religions is not, in my own opinion, a defect. What is important is that a long stride has been taken in the investigation of one of the principal areas of human activity.

Part I of the new volume deals with the History and Method of the investigation. Part II analyzes Types of Sexual Activity among Females (Pre-Adolescent Sexual Development, Masturbation, Nocturnal Sex Dreams, Pre-Marital Petting, Pre-Marital Coitus, Marital Coitus, Extra-Marital Coitus, Homosexual Responses and Contacts, Animal Contacts, and Total Sexual Outlet). Part III, Comparisons of Female and Male, considers the anatomical, physiological, psychological, neurological, and endocrinological elements in sexual response. The material in Part III is drawn from many sources, only one of them being the case histories. This critical compilation stands as one of the most useful sections of the book. It is now possible for the authors to compare the two sexes in detail, and this is done repeatedly throughout Parts II and III. Major dissimilarities in sexual response are surprisingly few. "Since there are no essential differences between the responses of females and males to tactile and other sensory stimulation (Chapters 14, 15), such responses must depend upon internal mechanisms which are essentially the same in the two sexes (p. 690).

A very few errors were noted. *Mittelschmerz* and ovulatory bleeding are confused (p. 609, footnote 19), and the old and almost certainly incorrect idea that the seminal vesicles are a major storage place for sperm is perpetuated (p. 611).

Summaries at the ends of most of the chapters, a large bibliography, and a good index add to the utility of the volume. Format and binding are of high quality.

This book, like its predecessor on the male, will of course be of value to the physician, the sociologist, the human biologist, and the psychologist. But it contains information of deep importance also to others who are concerned with adolescent guidance, marital adjustment, legal reform, and social history.

THOMAS R. FORBES

THE SECOND SEX.

By Simone de Beauvoir; translated and edited by H. M. Parshley. Alfred A. Knopf, New York. $10.00. xxx + 732 + xiv pp. 1953.

The central thesis of this book is that since earliest recorded time women, as a group, have been forced to occupy a secondary place in the world in relation to men. In short, they may be considered as a minority group—comparable to the Jews, the negroes, or others, in spite of the fact that they constitute numerically about half the human race. The author maintains that their undesirable situation is no longer the result of necessity imposed by "feminine," i.e., inferior and handicapping, physical characteristics, although it doubtless had its historical origin in such physical "handicaps." The secondary position of women is now dictated by the strong environmental forces of educational and social tradition under the purposeful control of men. All this means that women have failed to occupy a place of dignity as free and independent equals to men in world affairs.

This general thesis is supported by a presentation of the biological aspects of women's existence and then by a hodgepodge of historical detail. Some of the latter is drawn from fiction and as evidence must be classed as such.

There can be no doubt that the book by the contemporary French writer presents an interesting and challenging thesis, but there is considerable doubt in my own mind that it should be classed with serious scientific works. Most of the so-called evidence is of philosophical as contrasted to orthodox scientific discipline. The American reader, who is familiar with the lot of European women in a specific profession—for example, medicine—will be quick to realize that the thesis presented by Mlle. de Beauvoir may have more application to the European than the American female.

The comments about the unscientific characteristics

of this book of course do not imply that there may not be some truth in its general thesis, but do suggest that the work must be considered as belonging to philosophy or belle lettres rather than science.

HOWARD W. JONES, JR.

METHODIK KRIMINALBIOLOGISCHER UNTERSUCHUNGEN. *By Arnand Mergen. Ferdinand Enke Verlag, Stuttgart.* DM. 6.80 (paper). viii + 60 pp. 1953.

According to Mergen, the principal aim of a criminological biological study should be the investigation of the crime genesis, that is, the determination of the origin and motive of the criminal act. He outlines the following method for collecting the "indispensible essential data" necessary in order to make a criminological biological study.

The director of the study should obtain a report from the mayor on the general background of the case, from the "Statesgeneral" on the criminal aspects, from the school inspector on scholarship, and from the prison doctor on the biological aspects of the case. The biological aspects include: the abnormal and pathological changes of the organs; medical anamnesis; endocrine disturbances; status of respiratory, digestive, and circulatory systems and reflexes; neurological state; analysis of urine, of blood, and of basal metabolism; and the Wassermann test. Electroencephalograms are recommended. The director should also make a comprehensive survey of the sociological factors by holding interviews with the subject and relatives.

The above method is employed at the present time by the Institute of Social Defense of the Grand Duchy of Luxembourg. An extensive bibliography is included.

CONRAD K. RIZER

MANUEL DE PRÉHISTOIRE GÉNÉRALE. *Third Edition. By Raymond Furon. Payot, Paris.* 1200 fr. (paper). 533 pp. + 6 pl.; text ill. 1951.

According to H.-V. Vallois, who has reviewed this "manual" in *La Revue Scientifique*, the following points are particularly noteworthy: This is the first real treatise in French on general prehistory. Its 4 parts (Géologie et Préhistoire; Biogéographie; Préhistoire; La Pierre Polie et les Metaux) indicate the broad conception of the author's view of prehistory, which is that of a natural science rather than that of a historical science, and which includes human paleontology and ancient geography as well as archeology. Himself a geologist, Furon has devoted special attention to this aspect of prehistory, although it is regrettable that he has given such weight to the theory of the relation of the glacial ages to a shift in the position of the earth's poles. The part on Biogeography deals first with the plants and animals of the Quaternary, then with the succession of faunas and floras during the Ice Ages. The origin of cultivated plants is included. There is a special chapter on the evolution of the primates and the origin of man, the latter part developing the view of two parallel lines, Neanderthal and pre-sapiens. The discussion of Prehistory proper includes an introductory chapter and 4 main chapters on the Paleolithic of Western Europe, the Paleolithic of Eastern Europe and Asia, the Paleolithic of Africa, and the Mesolithic, respectively. The fourth part of the book connects Prehistory to History by means of a succession of 5 chapters focused on the Near East: the Neolithic; the 5th and 4th Millenia; the 3rd Millenium, with the propagation of copper and the discovery of bronze; the 2nd Millenium, with the expansion of bronze from India and China to the Iberian peninsula; and finally the last millenium, the Age of Iron. An appendix treats briefly the questions of prehistoric man in Australia and North America. The work is abundantly illustrated, the style very heavy; and the index needs to be expanded.

THE ANTHROPOLOGY OF IRAQ. *Part II, No. 1: The Northern Jazira. Pap. Peabody Mus., Vol. XLVI, No. 1.*

By Henry Field. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge. $6.50 (paper). x + 148 pp. + 49 pl. 1951.

THE ANTHROPOLOGY OF IRAQ. *Part II, No. 2: Kurdistan. Part II, No. 3. Conclusions. Pap. Peabody Mus., Vol. XLVI, Nos. 2 and 3.*

By Henry Field. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge. $6.85 (paper). ix + 174 pp. + 76 pl. 1952.

CONTRIBUTIONS TO THE ANTHROPOLOGY OF THE CAUCASUS. *Pap. Peabody Mus., Vol. XLVIII, No. 1.*

By Henry Field. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge. $6.50 (paper). x + 154 pp. + 24 pl. + 1 folded map. 1953.

The three reports by Henry Field, listed above, are essentially presentations of detailed anthropometric descriptions of various tribal groups and other population units. The first two are continuations of previous reports and include data on the Shammar, Sulabba, Turkomans, and Yezidi of northern Jazira, the Kurds, Assyrians, Jews, Armenians, Gypsies, and Chaldeans of Kurdistan—all in Iraq. The third is devoted to the Osete, the Yezidi, and the Jews of the Caucasus. All of these are the results of field studies carried out in 1934, when the author visited Iraq and the Caucasus on behalf of the Chicago Museum of Natural History. In addition, the author has included miscellaneous notes on the ethnography of the people he is describing and has appended a number of items of interest.

The corpus of data is impressive in size and coverage,

obviously representing a vast amount of effort, and should be useful for students concerned with the physical variation of the population of this part of the world. Much information drawn from sources difficult of access is also made available here.

The principal lack is a thoroughgoing analysis of the data. Perhaps the fault lies in the absence of a clearly defined and negotiable problem around which the data might have been collected.

HARRY L. SHAPIRO

THE INDIAN TRIBES OF NORTH AMERICA. *Bull. Bur. Amer. Ethnol., No. 145.*

By John R. Swanton. Smithsonian Institution, Bureau of American Ethnology, Washington. $3.50. v + 726 pp. + 4 folded maps. 1952.

This great scholarly contribution to American ethnology will probably for all time to come remain a standard reference work on the North American Indian tribes. The general arrangement is by the 48 states, followed by Canada, Alaska, Haiti, Cuba, Puerto Rico, Jamaica, and Mexico and Central America. Within each geographical region the several tribes are arranged alphabetically, and for each tribe in its principal locality there is a discussion of linguistic connections, geographical location, history, population, and other notable matters. One may thus describe this work as the definitive reference work on these subjects. It does not, of course, attempt to include anything about the different cultural patterns of the Indian tribes. Both Bibliography and Index are extensive.

ARAPAHO CHILD LIFE AND ITS CULTURAL BACKGROUND. *Bull. Bur. Amer. Ethnol., No. 148.*

By Sister M. Inez Hilger. Smithsonian Institution, Bureau of American Ethnology, Washington. 75 cents (paper). xv + 253 pp. + 40 pl. 1952.

This comprehensive study records the customs, beliefs, and traditions of the primitive Arapaho Indians of the United States as found in the development and training of the child. It covers the Prenatal Period, birth, Postnatal Interests, Nursing and Weaning, Atypicial conditions, Names, Adolescence, Training Children, Mental Training, Training in Morals, Children's Diversions, Ceremonial Age Societies, "Medicine," Health, Religion and Supernatural Powers, Belief in Life after Death, Domestic Economy, Tribal Government, and Marriage. There is an extensive Summary, a Bibliography, and an Index. Since no monograph on this subject has heretofore been available, this one is certain to become a standard reference on the subject.

THE MODAL PERSONALITY STRUCTURE OF THE TUSCARORA INDIANS *As Revealed by the Rorschach Test. Bull. Bur. Amer. Ethnol., No. 150.*

By Anthony F. C. Wallace. Smithsonian Institution, Bureau of American Ethnology, Washington. 75 cents (paper). viii + 120 pp.; ill. 1952.

This monograph is an analysis and interpretation of 70 Rorschach protocols collected among adult Tuscarora Indians on their reservation near Niagara Falls, New York. This tribe is one of the least known of the Iroquois "nation," and it seemed desirable to attempt to describe the modal personality and striking deviants therefrom, and to make some comparison with other, better-known Indian tribes. For the latter purpose the Ojibwas were used. It was found that whereas 37.2% of the Tuscaroras fell within the modal class, only 4.9% of the Ojibwa sample fell within the modal Tuscarora class. "In other words: the Tuscarora are psychologically different from the Ojibwa, and the difference is probably sizable. . . . In general, the modal Tuscarora and the modal Ojibwa are both persons who have been more or less severely traumatized in early dependency relationships, and have in consequence developed a marked tendency to withdraw and to avoid too free expression of both dependency longings and the hostilities attendant upon their frustration. . . . The divergence in Ojibwa and Tuscarora personality lies rather in the different way in which the two peoples handle substantially similar personality problems. . . . The model Tuscarora . . . is much better able to undertake a wide range of social relationships."

ETHNOBOTANY OF THE RAMAH NAVAHO. *Reports of the Ramah Project, Report No. 4. Pap. Peabody Mus., Vol. XL, No. 4.*

By Paul A. Vestal. Peabody Museum of American Archaeology and Ethnology, Harvard University, Cambridge. $2.50 (paper). ix + 94 pp. 1952.

BIBLIOGRAPHY OF AFRICAN ANTHROPOLOGY 1937–1949. *Supplement to Source Book of African Anthropology, 1937. Fieldiana, Anthrop., Vol. 37, No. 2.*

By Wilfrid D. Hambly. Chicago Natural History Museum, Chicago. $1.50 (paper). Pp. 155–292. 1952.

The present supplement to the *Source Book*, which is now out of print, attempts to select and classify those titles of major interest and usefulness. There are 3 sections to the *Bibliography*, one by author's names, with full titles, one by subjects, and one by political regions. Appended is a list of about 260 periodicals which contain articles in this field. As every worker

and student knows, such bibliographies as this are invaluable. There are only too few of them.

EUGENICS. *Galton and After.*

By C. P. Blacker. Harvard University Press, Cambridge. $5.00. 349 pp. + 3 pl.; ill. 1952.

The author's long service as General Secretary of the Eugenics Society of Great Britain eminently fitted him for writing this book, which was undertaken to fulfil a twofold purpose: first, to provide a relatively short account of Galton's life and thought, particularly in respect to eugenics; and second, to describe the developments of eugenics since the death of its founder in 1911. The first part of the book draws heavily upon Karl Pearson's monumental *Life, Letters, and Labours of Francis Galton*, as well as on Galton's own writings, and succeeds admirably in sketching of the versatile, brilliant scientific life of the great Victorian.

Part Two is unfortunately disappointing. Although Blacker has dealt quite extensively with problems and changing views about population growth, intelligence and personality testing, genetics, and the positive side of eugenics, he has failed to reflect the full nature of the controversial debates over eugenics that have so occupied leading biologists and psychologists, as well as social scientists, within the past three decades. The discussion of the developments in genetics seems academic and poorly focussed on eugenics, except for the considerable space devoted to Lysenkoism in Russia. Muller's notable bombshell among the eugenists in 1932, in the form of his address on The Dominance of Economics over Eugenics, and the development of his ideas in other works, from *Out of the Night* to Our Load of Mutations, have been altogether ignored. Weinstein's notable essay, Palamedes, seems to have gone unread. Haldane's pungent criticisms, especially in *Heredity and Politics*, are not alluded to, and he is brought in only in an adverse light in his half-hearted defense of Lysenko. Hogben's critique is briefly dismissed. The great Swedish school of eugenics, represented on the one hand by Alva and Gunnar Myrdal, and on the other by Gunnar Dahlberg, are not mentioned; and the significant studies of the Copenhagen Institute of Human Genetics and their relation to the practices of sterilization and abortion for eugenic reasons in Denmark are also overlooked. The significance of the Scottish nationwide survey of intelligence in 1932 and 1947 is omitted from consideration, and the bearing of L. S. Penrose's extensive and illuminating studies of the biology of mental defect are slighted. The study of concordance and discordance in monozygotic twins and controls, which one might have supposed would have a special place in a book about Galton, takes cognizance only of the relatively old studies of H. H. Newman and his collaborators, and fails to so much as mention either the notable studies on criminality in twins by Lange and later students, or the classic work of Franz Kallmann on tuberculosis, longevity, schizophrenia, and other significant traits in twins. To sum up, all consideration of negative eugenics appears to have been rather deliberately excluded; and as for positive eugenics, one can obtain a far fuller and more balanced picture from Frederick Osborn's *Preface to Eugenics*.

Grateful as we may be to the author for his vivid portrait and appraisal of Galton, it must therefore be said that the book as a whole is weak. It would have been better not to have attempted Part Two, than to have given so partial and so false a view of modern thinking about eugenics.

BENTLEY GLASS

THE CHALLENGE OF MAN'S FUTURE.

By Harrison Brown. Viking Press, New York. $3.75. xii + 290 pp. 1954.

Of this sharply probing analysis of human biology and man's economic future even the authorship is startling. Harrison Brown is neither a biologist nor an economist, but a geochemist honored for research in pure chemistry. He has been associated with Oak Ridge nuclear developments, and is editor of the *International Catalogue of Meteorites*. His earlier book, *Must Destruction be Our Destiny*, seems a far more logical outcome from his scholarship. But no one could have presented more clearly than he has done the present depressing world-wide picture of exploding birth rates and lagging development of resources—food, energy, "things." His 7 chapters are long and meaty. They inquire carefully into man's collective future on earth. To give perspective Harrison Brown has traced the ecological succession of a hypothetical valley into which early Man migrated. Through normal reproductive processes the human population grew there until the food available per person dwindled and a combination of disease, accident, and emigration kept the total number approximately constant. Whenever a major epidemic killed off large numbers, there followed a temporary period of prosperity due to the availability to the survivors of more food per person. With domestication of plants and animals, food production rose, and with it, the population. But with specialization of labor came urbanization, and from it, technical improvements permitting the city folk to muitiply through water and food brought in from the surrounding area. As the cities grew, increasingly larger areas had to be tapped for raw materials; commerce developed. But eventually the soil became depleted, urbanization of remote areas cut off the supply of raw materials and food imports, and the culture crumbled. "Civilization had in truth brought a golden age to 3000 nobles and persons of

wealth. But the historians . . . failed to appreciate that the 3 million peasants, common laborers, and slaves, who had tilled the fields or lived and worked in the dirty cubicles of the cities, had been no better off than their neolithic predecessors." The civilizations of Egypt, Greece, and Rome appear to have followed this succession. Great Britain may be a modern parallel in the penultimate stage.

Harrison Brown concludes that "the future course of history will be determined by the rates at which people breed and die, by the rapidity with which non-renewable resources are consumed, by the extent and speed with which agricultural production can be improved, by the rate at which the underdeveloped areas can industrialize, by the rapidity with which we are able to develop new resources, as well as by the extent to which we succeed in avoiding future wars. All of these factors are interlocked. . . ." He then proceeds to analyse each in turn: vital statistics, food, energy, materials. Far less is said about the secondary approach through conservation of renewable resources than about the primary approach through reduction of the birth rate to match the death rate. He is less pessimistic about the prevailing attitude of the Roman Catholic church toward contraception, in so far as this affects European countries and English-speaking parts of North America, than as it affects world-wide action in Asia, Africa, and Latin America, where industrialization cannot keep up with either the birth rate or the depletion of the land.

He looks, in the future, to three possible patterns of life. "The first and by far the most likely pattern is a reversion to agrarian existence . . . a pattern which will almost certainly exist unless man is able to abolish war . . . and . . . stabilize populations." A second possibility is the "completely controlled, collectivized industrial society." The third, which would be hardest to achieve or maintain, but the most desirable by far, is that of the "world-wide free industrial society in which human beings can live in reasonable harmony with their environment." And, as he must, the author leaves the solution up to man, hoping against hope that intelligence will be used instead of emotional provincial selfishness.

LORUS J. & MARGERY J. MILNE

MAN'S MOST DANGEROUS MYTH. *The Fallacy of Race. Third Edition.*

By M. F. Ashley Montagu; Foreword by Aldous Huxley. Harper & Brothers, New York. $5.00. xxiii + 362 pp. 1952.

The author's point of view on the matter of race has not been radically altered since the second edition of this book was published (*Q.R.B.*, 21: 127. 1945). The bibliography has been doubled in size and the subject matter and references brought up to date. Material from four articles previously published in journals by the author has been used. These dealt respectively with The Intelligence of Southern Whites and Northern Negroes, The Improvement of Human Relations through Education, Some Psychodynamic Factors in Race Prejudice, and Natural Selection and the Mental Capacities of Mankind. New material in the appendices deals (a) with the UNESCO Statement on Race; (b) the fight of ex-Representative Andrew J. May to get distribution of the pamphlet *The Races of Mankind* banned from wartime distribution to the Army; (c) the terms "abolition" and "emancipation"; and (d) a quotation of Freud's views on the Ego and group relations.

STATEMENT ON RACE. *Second Edition.*

By Ashley Montagu. Henry Schuman, New York. $2.00. xiv + 182 pp. 1951; 1952.

WHAT IS RACE? *Evidence from scientists.*

Produced by the Department of Mass Communication of UNESCO; illustrations by Jane Eakin Kleiman; text by Diana Tead. United Nations Educational, Scientific & Cultural Organization, Paris; [Columbia University Press, New York]. $1.00 (paper). 88 pp.; ill. 1952.

THE RACE CONCEPT. *Results of an Inquiry. The Race Question in Modern Science.*

United Nations Educational, Scientific, & Cultural Organization, Paris. 50 cents (paper). 103 pp. 1952.

These three publications may very well be considered together, for they all deal with the same subject, the development and interpretation of the UNESCO Statement on Race, which was issued in 1950 after lengthy deliberation by a Committee of Experts. The original statement, framed largely by sociologists, led to widespread discussion and some disagreement, and the upshot of this was a new Statement on the Nature of Race and Race Differences, issued by UNESCO in September, 1952. This revised statement was framed by a wide circle of physical anthropologists and geneticists, admittedly those groups within whose special province fall the biological problems of race. In the main, the conclusions of the first statement were sustained, but there were some significant deletions and there was some shift of emphasis.

Ashley Montagu's book is a point by point consideration of the original statement, in the making of which he participated. His volume has simply had added to it the text of the revised statement made by the physical anthropologists and geneticists.

The attractive, modernistic booklet *What Is Race?* is based on a UNESCO pamphlet by L. C. Dunn (*Race and Biology*), and to a lesser extent on others written

by Otto Klineberg (*Race and Psychology*) and by Michel Leiris (*Race and Culture*). *What is Race?* is prepared for the completely uninformed, and includes in 4 appendices Some Suggestions for Group Discussion, the Statement on Race—1950, the revised Statement on the Nature of Race and Race Differences, and a list of a few books on the general subject.

The pamphlet entitled *The Race Concept* will probably be of most interest to biologists, since it gives, in addition to the text of the revised statement on the nature of race and race differences quite a complete account of all the divergent opinions, criticisms, and reservations submitted to the drafters by all of those geneticists and physical anthropologists who were consulted and who replied. These are given seriatim section by section. Certain more extensive suggestions or alternative statements by A. Lipschutz, T. Dale Stewart, and Th. Dobzhansky follow, and the account ends with a reformulation in the light of the comments and a statement in the form of a report, by L. C. Dunn. The full list of all who were invited to comment, whether or not they replied, is given.

BACKGROUNDS OF HUMAN FERTILITY IN PUERTO RICO. *A Sociological Survey.*

By Paul K. Hatt. Princeton University Press, Princeton, New Jersey. $5.00 (paper). xxiv + 512 pp. 1952.

This sober statistical survey of popular opinion in Puerto Rico regarding the customs and practices that influence fertility provides the background for the impassioned, and indeed almost hair-raising, commentary on the population problem in that crowded island by Robert Cook (*Human Fertility: the Modern Dilemma*).

According to the study by Hatt, which is based on a sampling of opinion by interviews, the overall pattern of fertility in Puerto Rico has been downward since World War I, but an increasing proportion of ever-married persons has tended to counter and compensate for that trend, so that in spite of the decrease in marital fertility, Puerto Rican rates are still very high indeed. Nevertheless, attitudes and values favorable to low fertility are widespread throughout the island. The modal preference in family size, for example, is for two children as the ideal, and there is a common desire to raise the age at marriage beyond the present average. Thus, a general acceptance of low fertility values exists alongside high fertility practice. A broad program that would make available, to persons who hold low fertility values but whose actual fertility is high, the necessary means to implement their values seems more practicable to the author than a program designed to change values themselves. This seems particularly valid in view of the fact that Puerto Rican youth seem already to have shifted very largely to low fertility values. Education, rising levels of consumption, and urbanization all tend to bring this about.

COLONIAL DEVELOPMENT AND POPULATION IN TAIWAN. *By George W. Barclay. Princeton University Press, Princeton.* $5.00. xviii + 274 pp.; ill. 1954.

Concerning Taiwan there is an unique mass of very detailed demographic data relating to the Chinese-type Taiwanese. This unusual example of an isolated, carefully controlled, principally rural population may have great significance for various regions in Southeastern Asia, particularly if other regions benefitting from modern public health services fall under new types of administrative control. Under the Japanese health authorities, simple measures were energetically applied on a mass scale, greatly reducing the death rate in Taiwan. The existing social order was carefully maintained, the "pao-chia" system managed most administrative details of local government. The high fertility and rapid increase of the population have been conspicuous. Urban development, except for the few Japanese, was usually not encouraged. The Japanese, through heavy taxation, charges for capital services, conscription of labor, and manipulation of farm prices, kept the greater part of the capital to themselves. This book considers many phases of a most interesting example of what can be done in reducing mortality in a population while keeping it in agrarian activities, and reserving the financial control and most of the profits for the masters. In presenting his reliable and very detailed demographic data, and considering it from many points of view, the author avoids any possible comparisons. The lessons that are most pertinent to this example, however, cannot be drawn from it alone, but can emerge only from comparison with other parts of the world.

ROBERT L. PENDLETON

THE GEOGRAPHY OF EUROPE. *Second Edition.*

By George D. Hubbard. Appleton-Century-Crofts, New York. $6.75. xvii + 870 pp.; ill. 1952.

The first edition of this textbook, which is arranged according to a climatological pattern (Lands Having Mediterranean Climate; Lands Having Marine Climate; Baltic Lands—Transitional Climate; The U.S.S.R.—Continental Climate; Central States—Transitional Climate; and Lower Danube States), was published in 1937. Obviously many changes were necessary to revise the political and economic treatment. New boundaries, revised statistics, and the "iron curtain" have greatly altered not only facts but

also outlooks. More than 170 new halftone illustrations (not too well reproduced) have been included. Biologists will find this a good general reference to European geography at a relatively elementary level. Population and agriculture are treated among other topics, but the principal emphasis is economic. Ethnology seems to have been ignored.

CONTEMPORARY ETHIOPIA.

By David Abner Talbot. Philosophical Library, New York. $4.50. x + 267 pp. 1952.

In spite of the author's employment as a teacher in Ethiopia for years, and his sympathetic understanding of the people, this book rather inadequately treats of the physical characteristics and the people of this most ancient country in Africa. Certainly the text would have been much more intelligible with the use of even some very simple maps, and would have been made much more interesting through the use of illustrations. It is evident that a number of dedicated advisers have played an important part in assisting the leaders in Ethiopia to develop a backward people of outstanding character and an "under-developed" country into a progressive one. What a challenge to the Powers in their often selfish and short-sighted attitudes.

ROBERT L. PENDLETON

DE OMNIBUS REBUS ET QUIBUSDAM ALIIS

CHANGE AND HISTORY. *A Study of the Dated Distributions of Technological Innovations in England. Viking Fund Publ. Anthropol., No. 18.*

By Margaret T. Hodgen. Wenner-Gren Foundation for Anthropological Research, New York. $4.50. 324 pp. + 10 folded maps; ill. 1952.

The purpose of this publication is "to shed light on the temporal and geographical incidence of technological changes, but much more important, to offer substantial evidence of the recurrence and classifiability of dated events and their consequent responsiveness to scientific method." It is a study of innovations and innovators in England from the 10th to the 20th centuries, an anthropological problem, describing the background and the gradual beginnings and development of the so-called Industrial Revolution.

ROBERT L. PENDLETON

INDUSTRIAL SCIENCE. PRESENT AND FUTURE. *A Collection of papers presented at the installation of the Section on Industrial Science of the AAAS at the Philadelphia meeting on December 28–30, 1951. Arranged by Allen T. Bonnell; edited by Ruth C Christman. American Association for the Advancement of Science, Washington.* $2.00 (paper). viii + 152 pp.; ill. 1952.

Of particular interest to the biologist, among the papers included in this symposium, are the two following: The Pharmaceutical Industry (Ernest H. Volwiler); and Industrial Science and Community Health (Charles L. Dunham). In general, the petroleum, steel, communications, and chemical industries and their problems dominated the viewpoints of the oher speakers, except for Alan Waterman of the National Science Foundation. In any case, the picture of the developing dependence of government and industry alike on the fruits of science is one that must interest and concern every scientist, whether biologist or not.

PAPERS OF THE MICHIGAN ACADEMY OF SCIENCE ARTS AND LETTERS. *Vol. XXXVI (1950).*

Edited by Eugene S. McCartney and Frederick K. Sparrow. The University of Michigan Press, Ann Arbor; Geoffrey Cumberlege, Oxford University Press, London. $6.50. xii + 352 pp. + 32 pl. + 2 folding maps; text ill. 1952.

Among the contents of this volume are a number of papers of a biological nature, as follows: *Botany:* Seasonal Aspects of the Bermuda Algal Flora (A. J. Bernatowicz); Permanent Mounts of Agar Plates of Streptomyces for Use as Herbarium Specimens (K. L. Jones); The Development of the Young Vegetative Mycelium in Streptomyces (K. L. Jones); Inheritance in *Cucurbita pepo* (E. B. Mains); Reproduction of *Acrosymphylon caribaeum* (W. R. Taylor); Vascular Development and Transition in *Echinacea purpurea* (J. W. Unger); Increased Multiplication and Other Effects of Irradiation on Tulip Bulbs (T. Vergeer); *Forestry:* Some Resupinate Polypores from the Region of the Great Lakes. XXII. (D. V. Baxter); Recent Forest Tax Legislation in New Hampshire (J. W. Brown); The Montana Conservation Council: a Significant Experiment in Conservation Organization (K. P. Davis); Red Pine Growth Ten Years after Thinning (L. M. G. Engle & N. F. Smith); *Zoology:* Migrant Geese in Northern Michigan (G. A. Hesterberg & E. A. Bourdo, Jr.); A Revision of Families of the Spiders in Michigan (A. M. Chickering); Repopulation of an Area Denuded of Pheasants (*Phasianus*) by Spring Flooding (R. A. MacMullan); A Critique of Methods for the Measurement of Parasitic Worms (M. J. Ulmer); *Medical Science:* Ultrastructure of Leukocytic Granules and Their Electron Microscopy (J. W. Rebuck); *Psychology:* Anxiety in the College Classroom (W. J. McKeachie).

It is a grave question whether a volume of such diversified biological content, to say nothing of the

inclusion of other sections upon random subjects of geography, geology, anthropology, economics, folklore, landscape architecture, language and literature, philosophy, and political science, will appear to any purchaser. However, the four main parts, Botany and Forestry, Zoology, Geography and Geology, and General Section, are purchasable separately in paper covers.

LABORATORY TECHNIQUE IN BIOLOGY AND MEDICINE. *Third Edition.*

By E. V. Cowdry. The Williams & Wilkins Company, Baltimore. $4.00. xxxi + 382 pp. 1952.

The third edition of this indispensable handbook has been issued only 4 years after the second edition. The revision was necessitated by the large number of new techniques which were developed during the war period and which only received publication from 1948–1951, together with the rapidly developing scope of electron microscopy, phase microscopy, microchemistry, and the use of radioactive tracers. Although many of the newer techniques have not yet been fully evaluated, they have been described either by the original investigators or by others who have had extensive experience with them. The extent of this collaboration is shown by the acknowledgments to 69 persons for descriptions of 108 techniques. The dictionary type of arrangement has been retained, and makes this reference work by far the most useful one for obtaining information quickly, although the user may need thereafter to refer to a more detailed and specialized treatment of the topic.

PRATIQUE DU LABORATOIRE. *Techniques Générales; Diagnostics Biologiques; Hématologie, Sérologie; Parasitologie et Entomologie Médicales; Technique Anatomo-Pathologique.*

Editors: Ch. Jaulmes, A. Jude, and J. Quérangal des Essarts. Masson & Cie., Paris. 3000 fr. (cloth); 2500 fr. (paper). viii + 699 pp. + 4 pl.; text ill. 1951.

This very extensive handbook of medical laboratory methods is divided into 5 main parts, as indicated in the subtitle: general laboratory techniques; biological diagnostic methods (including bacteriological, viral and bacteriophagal, cutaneous, and hormonal); hematological and serological methods; parasitological and entomological methods; and finally, anatomical-pathological technique. It is a serious question, however, whether this type of handbook is of the usefulness its size would appear to promise. What laboratory worker will need so huge an array of methods? On the other hand, within the special fields where delicate tests are often necessary, such a book, big as it is, can give only the elementary, classic techniques. For example, the determination of Rh antigens and antibodies is covered in 5 pages, only tube methods being given, while the more sensitive and widely used tests, such as the Coombs test, are dismissed in a single paragraph. To be sure, our American medical laboratory handbooks, such as Kolmer's, do the same. But that does not weaken the argument that more restricted, specialized handbooks are both more useful to the individual worker and also more readily kept up to date by the editors, who don't have to cover the water-front.

BENTLEY GLASS

TOMORROW, THE STARS. *A Science Fiction Anthology. Edited and with an introduction by Robert A. Heinlein. Doubleday and Company, New York.* $2.95. 249 pp. 1952.

These 14 stories are all written in the best tradition of scientific verisimilitude. The last one, by the title of "Poor Superman," and written by Fritz Leiber, could well have come from the pen of George Orwell. It offers a chilling glimpse of a world quite different than that of *1983*, yet equally repelling and perhaps even more probable. The fate of scientists in the era of the "Thinkers" makes bitter food for thought.

BENTLEY GLASS

A LIST OF ABBREVIATIONS OF THE TITLES OF BIOLOGICAL JOURNALS, *Selected, by permission, from the "World List of Scientific Periodicals." Second Edition. Issued by The Biological Council. H. K. Lewis & Company, London.* 2s. 6d. (paper). iv + 32 pp. 1954.

This helpful list is heartily and emphatically recommended to all contributors of review papers to the *Quarterly Review of Biology*. It contains over 900 abbreviations of commonly used biological and general scientific journals, and while not every abbreviation one may need is included, nevertheless it will be of great service to those who do not have the bulky and expensive third edition of the *World List* at hand.

In general, the abbreviations adopted by the *World List* are so much shorter than those in current use in the United States (by *Chemical Abstracts*, *Biological Abstracts*, etc.) and are based on such sensible principles that they deserve general scientific adoption, like the metric system of measurement. The main principles are as follows: abbreviation is normally effected by cutting off the ends of words, and not by contraction; cognate words having the same significance in different languages are reduced to the same form; nouns begin with a capital and other words with a small letter; and the place of publication is

added whenever the abbreviation fails to reveal the language of the publication. These principles, and others applied in the *World List*, were adopted by the *Code international d'Abréviations des Titres de Périodiques* (1930; 1932) and revised by the International Organization for Standardization (ISO), beginning in 1948. The scientists and editors of the United States now constitute the principal obstacles in the way of further progress in international cooperation along these lines.

BENTLEY GLASS

FRENCH BIBLIOGRAPHICAL DIGEST. *Science: Geography, 2. No. 10 (Series II). April, 1954.*

Edited by Georges Assié. Edited and published by The Cultural Division of The French Embassy, New York. To libraries, university departments, and scientists, free upon request (paper). 68 pp. 1954.

FOREST RESEARCH IN INDIA, 1948–49. *Part I. The Forest Research Institute. Part II. Reports for Burma and Indian Provinces.*

Published by the Manager of Publications, Delhi. (I) Rs. 8.6 As.; 13s. 6d. (paper). (II) Rs. 5/–; 8s. 0d. (paper). (I) iv + 112 pp. (II) iv + 72 pp. 1952.

These reports published by the Forest Research Institute at Dehra Dun are a welcome contribution to the world's forestry literature. One of their especially valuable features is the happy compromise they demonstrate between the occupational tendency, usually characterizing such reports, to include either too little detail or too much. The reports will be of special interest to western foresters who are interested in acquiring a [illegible] search meth[illegible]

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Theoretical papers are published occasionally, especially when such papers (1) include a critical synthesis of the literature bearing on the theory and (2) are likely to promote further research in a given field.

The article should be written in concise language, yet in sufficiently non-technical form as to be intelligible not only to specialists in other fields but to the general biologist as well. To this end the article should have a general introduction and a summary which enumerates one by one all of the principal facts and conclusions given in the paper. Interpretative diagrams and

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SCOTT S. PAULEY

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The subjects and authors of articles are selected by the Editors and members of the Advisory Board. Unsolicited articles which conform with the objectives of the Quarterly will be considered for publication.

A feature of the REVIEW is the section dealing with *New Biological Books*. In this department the book literature of different countries in the field of Biology is given prompt notice.

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